FROM FORAGING TO FARMING IN THE ANDES

New Perspectives on Food Production and Social Organization

TOM D. DILLEHAY

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Archaeologists have always considered the beginnings of Andean civilization from ca. 13,000 to 5,000 years ago to be important in terms of the appearance of domesticated plants and animals, social differentiation, and a sedentary lifestyle, but there is more to this period than just these developments. During this time, the spread of crop production and other technologies, kinship-based labor projects, mound building, and population aggregation formed ever-changing conditions across the Andes. *From Foraging to Farming in the Andes* proposes a new and more complex model for understanding the transition from hunting and gathering to cultivation. It argues that such developments evolved regionally, were fluid and uneven, and were subject to reversal. This book develops these arguments from a large body of archaeological evidence, collected over thirty years in two valleys in northern Peru, and then places the valleys in the context of recent scholarship studying similar developments around the world.

Tom D. Dillehay is the Rebecca Webb Wilson University Professor and Distinguished Professor of Anthropology, Religion, and Culture at Vanderbilt University. He has conducted numerous archaeological and anthropological projects in Peru, Chile, Argentina, and other South American countries and the United States. He is the author of *Monuments, Empires, and Resistance: The Araucanian Polity and Ritual Narratives*, as well as numerous other books and articles.

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New Perspectives on Food Production and Social Organization

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Foreword

While it is commonly accepted that the Central Andes constitute one of the few centers of early plant domestication, there is not much agreement about the basic questions like specific places of "origin," timing, process, and the region's relevance for early social and economic developments toward sustained social complexity.

In the early 1940s but based on earlier hypotheses, Julio C. Tello constructed an "agrotechnical" chain of human responses to environmental challenges. It starts in the eastern lowlands with extremely simple cultivation (basically manioc) combined with fruit collecting, hunting, and fishing. In the humid eastern slopes of the Andes, terracing was needed to improve the growing of crops, whereas in the upper highlands new plants were added like oca, quinoa, and potato. There, large concentrations of camelids and cervids together with a most benign climate turned puna and quechua into the "principal centers of human attraction in the remote past." These plants, and particularly the potato, according to Tello, are capable of growing almost without human intervention. "Since the most remote times there was a migration of plants from highlands downwards and from the lowlands to the highlands" so that the coast receives many plants like fruit trees, coca, chili pepper, manioc, sweet potato, maize, and others "which grow easily in the montaña but need much attention on the coast" (Tello 1929: 21–22, 1942: 596–615). Thus, Tello stresses several points of major interest like domestication as an early cultural development: simple technology, combination of resources, transfer of domesticates, and generally a network of connections between lowlands, highlands, and coast.

In the 1950s and 1960s, Federic Engel's extensive surface surveys and excavations concentrating on early sites on the whole stretch of the Peruvian coast and some adjacent highland areas produced an enormous amount of well-preserved plant remains and contextual data. Unfortunately, these

were only summarily presented, and the lack of systematic analyses did not lead to convincing models for the emergence of early agriculture.

In the 1970s, Michael E. Moseley published his controversial book *Maritime Foundations of Andean Civilization* (1975). In spite of much criticism, the idea of "Peru as an exception of the rule" in the way of stressing the vital importance of marine resources for the emergence of a relatively late social complexity became popularized and often is accepted as a fact by public opinion in spite of also accepting Peru as a center of early plant domestication. The reasons for this contradiction are manifold and cannot be discussed at length here, but certainly one of these is the general conviction that a kind of cultural "civilization package" including domestication is abruptly emerging with the "Chavín phenomenon" in the sense that "Paleolithic" life ways almost automatically evolved into an elaborate complex social system. Even the much more ancient Caral on the north central coast in this sense is only a projection of this idea of full-blown complexity without antecedents into a more remote past. This means that a wide conceptual gap is created between early "primitive" colonization or "Early Man" and the much later splendorous achievements seen as the "origin" of civilization and ultimately the modern state.

Bridging this gap is one of the principal aims of this book. However, it is not a lengthy discussion of the theoretical strengths and weaknesses of previously published theories, hypotheses, ideas, or speculations but a presentation of a circumscribed area in northern Peru (lower and middle Zaña and Jequetepeque valleys and adjacent northern lower and middle Chicama Valley) with a total of more than 500 Preceramic sites studied during the last thirty years, mostly by Tom D. Dillehay and his research team. The high amount of data obtained during this long-term research allows an orientation toward concrete problems concerning "the interpretation of historical moments and specific sociocultural and techno-environmental contexts forming larger patterns" (see Chapter 15). These patterns are defined in a total time span of almost 9,000 C14 years (13800 to 5000 BP) in three phases: El Palto, Las Pircas, and Tierras Blancas. Special attention is drawn to plant use as utilized animals generally are of small size (land snails, lizards, foxes) apart from some deer and others; marine resources apparently are minor components (Chapter 10).

Concrete evidence of domesticated plant remains is surprisingly early but rather tenuous in the shape of *Cucurbita* seeds in the late El Palto phase contexts from the upper valley interpreted as evidence of squash cultivation. It occurs in a "diverse physical and conceptual landscape where the contrast between a few settled household communities in the Nanchoc area

and numerous large and small temporary campsites and semi-permanent localities in other areas were pronounced in a geographical, environmental, and cultural sense" (Chapter 15). This means that some human groups during the Paijánense, usually understood as the typical early broad spectrum foragers, were taking steps toward sustained complexity. But it is fluctuating diversity and dynamism that characterize this early social world, not uniformity and definite change.

During the following Las Pircas phase (9800 to 7800 BP) the repertoire of domesticated plants is significantly enlarged with peanuts (*Arachis hypogaea*), probably quinoa (*Chenopodium* sp., cf. quinoa), manioc (*Manihot* sp.), beans (*Phaseolus* sp.), and pacae (*Inga feuillei*). The mere presence of these domesticates involves some connection with the outside world as most of these presumably arrived from distant centers. But as their status as domesticates is not totally clear (Chapter 9), many of those could represent "pre-domestication cultivation," which would be of major importance as such.

Related to these innovations are more permanent households, house gardening, and mound building (in the late part of the phase). These in turn are linked to increased ritualism like garden magic and cannibalistic treatment of the dead. This cannibalism, however, is not necessarily a sign of violence but could have been a kind of endocannibalism as was practiced among the Yanomamö (Venezuela) who cremated their dead and drank their crushed bones or ashes (Chagnon 1968: 50–51, 1992: 136–137). These are all signs of social cohesion, a construction of a new social landscape or world, manifested by a new center of a restricted "world" at the end of the phase, while on the outside others maintained their different modes of foraging.

The Tierra Blanca phase (7800 to 5000 BP) documents the climax of this tendency. Irrigation canals and increased use of domestic plants already present in the preceding phase as well as an expansion toward lower elevations down to the coast, more formalized architecture and communal ceremonialism show a consolidation of "neolithic" life, but it was a slow and localized process in which climate change or population pressure probably were not prime movers for change. The authors of this book prefer a combination of cognitive, social, technological, and ecological pathways. Of particular importance is the construction of dual mounds in the late Las Pircas phase maintained until the end of the Tierra Blanca phase. These seem to fulfill ritual functions as shown by the existence of lime (probably for coca chewing) and rock crystals. Until now it is the earliest structure of this type that develops into a hallmark for late Preceramic and Formative

centrality. The earliest of these dates to about the abandonment of the Nanchoc mound (Fuchs et al. in press). At about 5000 BP the Nanchoc pocket seems to be definitely abandoned.

As the authors recognize, there are gaps and problems still to be resolved, but this coherent picture should be contrasted with similar or different histories in other parts of the Andes. Finally, this complex mosaic of emerging social complexity in all its relevant aspects should be compared to other, much better known, centers like the Near East. In order to achieve this ambitious aim, there are some basic points to be considered:

1. Building up of a significant database concerning technological, ecological, cognitive, and social evidence as was done in the presented research area. Following the authors, technology includes architecture, irrigation canals, garden plots, and agricultural fields as well as materials, in particular, lithics (see Chapter 11). The most basic prerequisite is recognizing lithics in the field (most surface survey reports from the Andes start with ceramic sites, ignoring lithics almost entirely) and their organizing into meaningful temporal-spatial units in order to create a chronological, robust frame. While this is rather clear for the Early Holocene (Early Archaic) because of the common presence of bifacial points, it is less clear for the almost 5,000 years that precede the ceramic phases. This time span, however, seems to be crucial for the emergence of observable cultural patterns that are characterized by diversity and coexistence of different expressions of complexity in different parts of the Andes. Evidence for gardening and agriculture should be sought in pockets of similar characteristics as the Nanchoc area in the *chaupiyunga* of the middle valleys of the western and eastern Andes, but these are usually woefully neglected. Other areas like the humid forests, the coastal wetlands, and the interandean valleys are less covered by Dillehay and his teams (due in large part to the absence of early sites along the coast, although he is currently engaged in intensive research in the coastal Chicama Valley), and even marginal areas like the puna rims should provide useful evidence.
2. Research, recovery, and analyses of the evidence have to be undertaken with the participation of experts in different fields in order to achieve meaningful results. While this has been done in several sites in the Andes, the gained insights about these are difficult to be generalized as they tend to neglect regional diversity and prevent the recognition of networks. In other words, only regional studies are

capable of detecting the interrelation of sites and places in changing landscapes.

3. An important point, rightly stressed by the authors, is the relevance of cognitive aspects. Early societies like those at Nanchoc are not to be understood as congregations of *Homo economicus*; domestication is not a simple economic need, but it is part of the mechanisms of socialization materialized in objects and contexts that hint at ritualized communities with concepts of identity and memory (fertility cults and ancestry) in coherent worldviews. Centrality as expressed in long-term cult centers in the form of mounds is an astonishingly early phenomenon at Nanchoc, but it very probably is not the only one of its time and not the earliest manifestation in the Andes.

In sum, the very relevant results presented in this book should serve as an orientation toward a renewed and redefined comparative research concentrating on the human presence during the early and the middle Holocene in the Andes. The tendency of generalized narratives of "success stories" from the primitive to the complex still prevailing in the extant literature is being revealed as an obstacle and a falsification by simplification. Therefore, the Central Andes probably did not constitute the "exception to the rule" (as Nanchoc cannot be the exception), as there were many "rules." This is certainly also true for the Near East. The southern Levant is no longer seen as the lone focus or "origin" of complexity. Southeast Anatolia and Syria are more complex and different in the PPNA (Pre-Pottery Neolithic; see Lichter ed. 2007), which is losing its status as an area of incipient domestication too, as undisputed domesticates only appear during the PPNB (9500–9200 BP), probably in different regions independently (Nesbitt 2002; Willcox 2002). Complex architecture and cultivation, however, are earlier (Banning and Chazan 2006; Stordeur and Willcox 2009). It is diversity more than uniformity that characterizes the bumpy steps to early complexity in this area (see Kuijt 2000).

Peter Kaulicke
Lima, Peru

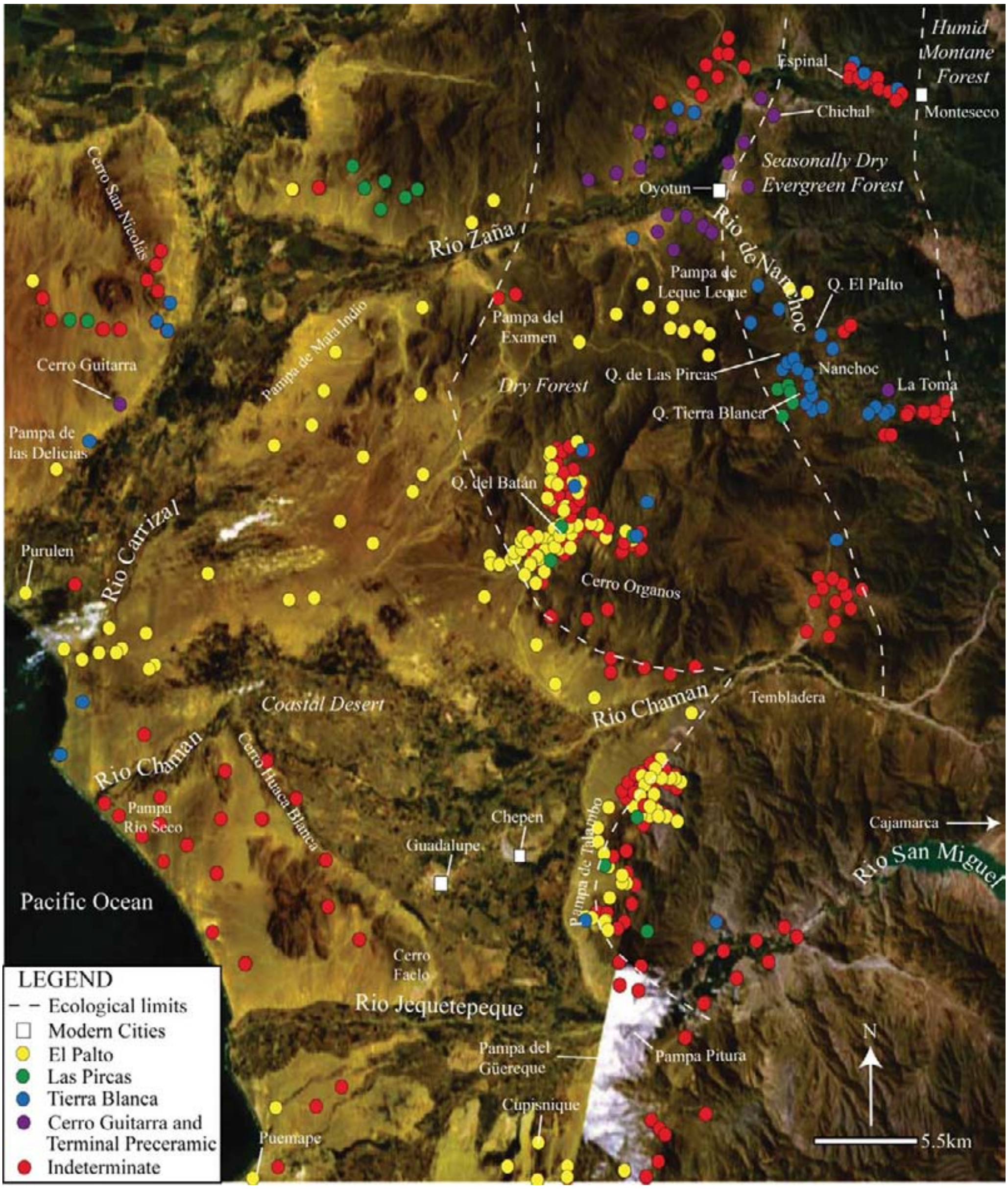

Plate 1. Satellite view of the lower Zaña and Jequetepeque valleys showing all Preceramic sites by phases across different ecological zones.

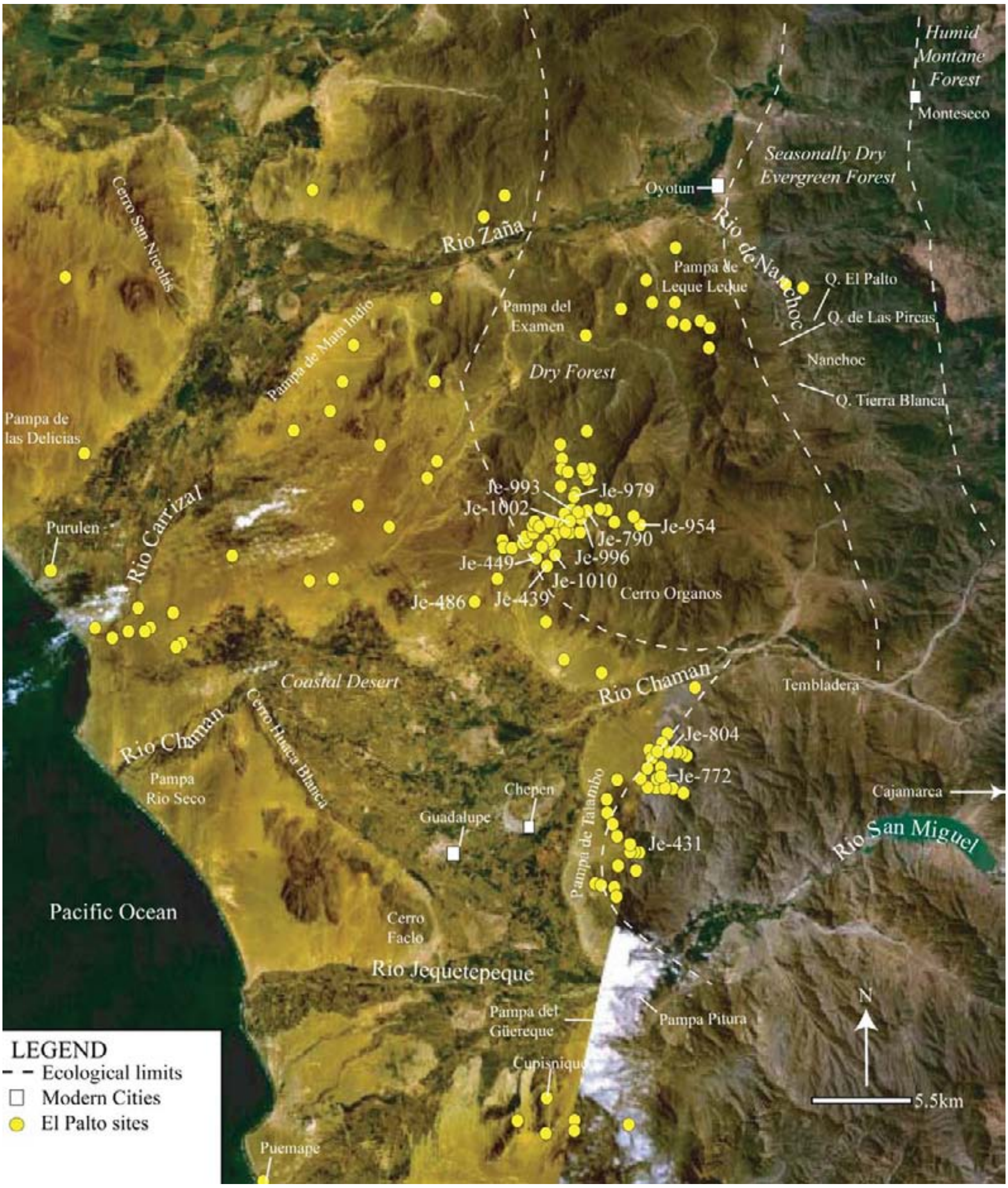

Plate 2. Location of El Palto phase sites in the study area.

Plate 3. Location of Las Pircas sites in the study area.

Plate 4. Location of Tierra Blanca phase sites in study area.

Acknowledgments

Patricia J. Netherly and I began archaeological work in the Zaña Valley in 1976; Jack Rossen joined us in 1984 and conducted his doctoral work in the area throughout the remaining 1980s. John W. Verano studied the human remains generated by our various projects in the valley. I continued working in the Zaña until 1997, at which time I moved to the next valley to the south, the Jequetepeque, to begin a different archaeological project with Alan Kolata. It was during this project that Greg Maggard and Kary Stackelbeck joined us, and they did their doctoral work in the early 2000s. Dolores Piperno carried out phytolith and starch grain analyses for projects associated with both valleys. Herbert Eling and Richard Schaedel are thanked for introducing me to the archaeology of the Jequetepeque Valley during the late 1970s. Many other scientists from various disciplines also worked on data retrieved from the projects, but they are not mentioned here because there are far too many of them to list. However, their articles and reports are cited throughout this book. During the past thirty-plus years of these projects, we have received so much assistance and support from these scientists and from friends, colleagues, and students in the way of material help, advice, and useful responses that any list of acknowledgments must be either incomplete or interminable. I apologize to anyone I have omitted.

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CHAPTER ONE

Introduction

Tom D. Dillehay

Of all human histories of the Andes, the initial peopling of the continent and the beginnings of indigenous civilization and food production have proven to be some of the more difficult to master. For most Andean scholars, pre-Hispanic civilization is seen to begin with monumental architecture, public works of art – among other spectacular achievements–at large, permanent settlements such as Chavin de Huantar in the highlands and Caral on the coast of Peru before 3,000 years ago. (All dates in this volume refer to calibrated dates. BP refers to Before Present. Yet, several major social and economic foundations of civilization had already been in existence for several millennia. Archaeologists have always considered the earlier period from ~13,000 to 6,000 years ago to be important in terms of the appearance of domesticated plants and animals, social differentiation, and a sedentary lifeway, but there is more to this period than just these developments. The spread of crop production and other technologies, kinship-based labor projects, and population aggregation, for instance, formed a palimpsest of ever-changing conditions across many different environments of the Andes that created a patchwork of new transformations through time. This book examines these formations and transformations from the late Pleistocene to the middle Holocene in two valleys in northern Peru – Zana and Jequetepeque (Figs. 1.1, 1.2) – through a large body of archaeological evidence, and places them in the context of recent scholarship studying similar processes in other parts of the world. This evidence was gathered by a series of related archaeological projects that were carried out between 1976 and 2008. Synthesized and related here for the first time are both new and previously published data generated by these projects in the analysis of more than 570 Preceramic sites in the study area.

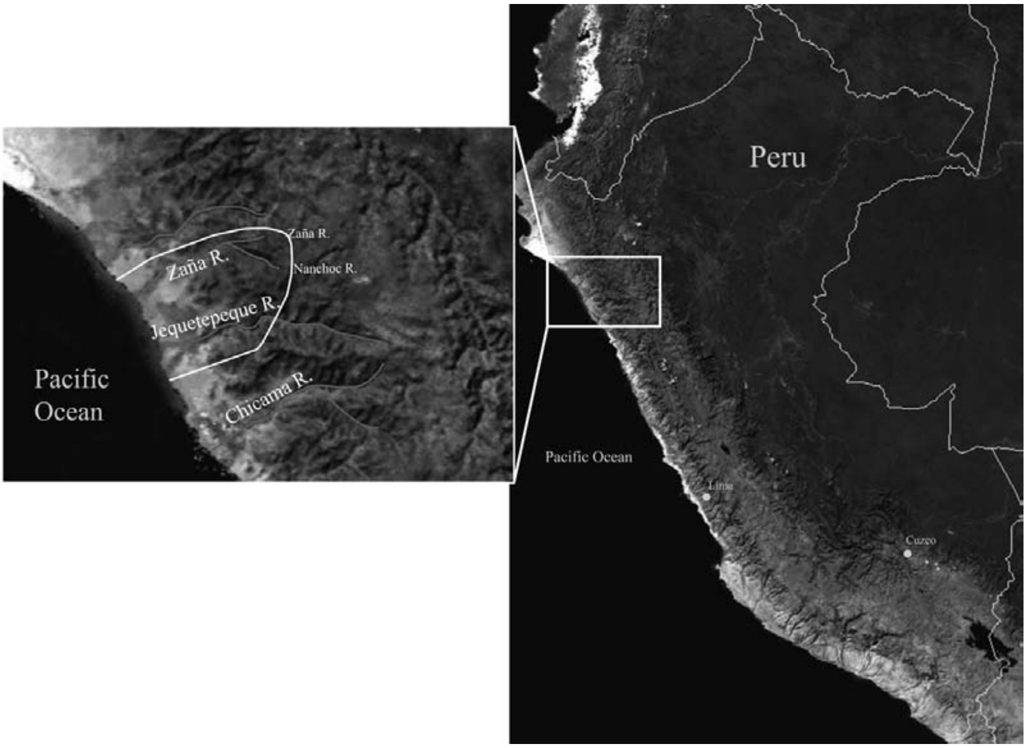


Figure 1.1. Location of the Zaña and Jequetepeque valleys on the north coast of Peru.

Previous explanations of these processes are being altered around the globe as new data become available and new ways of thinking about these processes appear. Recent studies have shown that not all Pleistocene peoples were highly mobile, big-game hunters; some were territorial foragers subsisting on a wide variety of local foods (e.g., Dixon 1999; Dillehay 2000a; Meltzer 2009). It is also becoming clear that domestication and food production, social complexity, demographic aggregation, new technologies, and response to environmental stress did not always form a "coherent cultural package of changes driving each other progressively forward" (Marshall n.d.) in the manner envisioned by neo-evolutionary thinking (c.f., Bar-Yosef and Meadow 1995; Gamble 2004; Sassaman 2008). New models now view early societies independently operating at different velocities and directions of change at different places and times around the world. Rather than viewing changes as having occurred rapidly as a consequence of reaction to certain "triggers," we now see that many developed slowly over centuries or millennia. We also realize that some foragers tried new food-producing strategies and then rejected some or all of them and

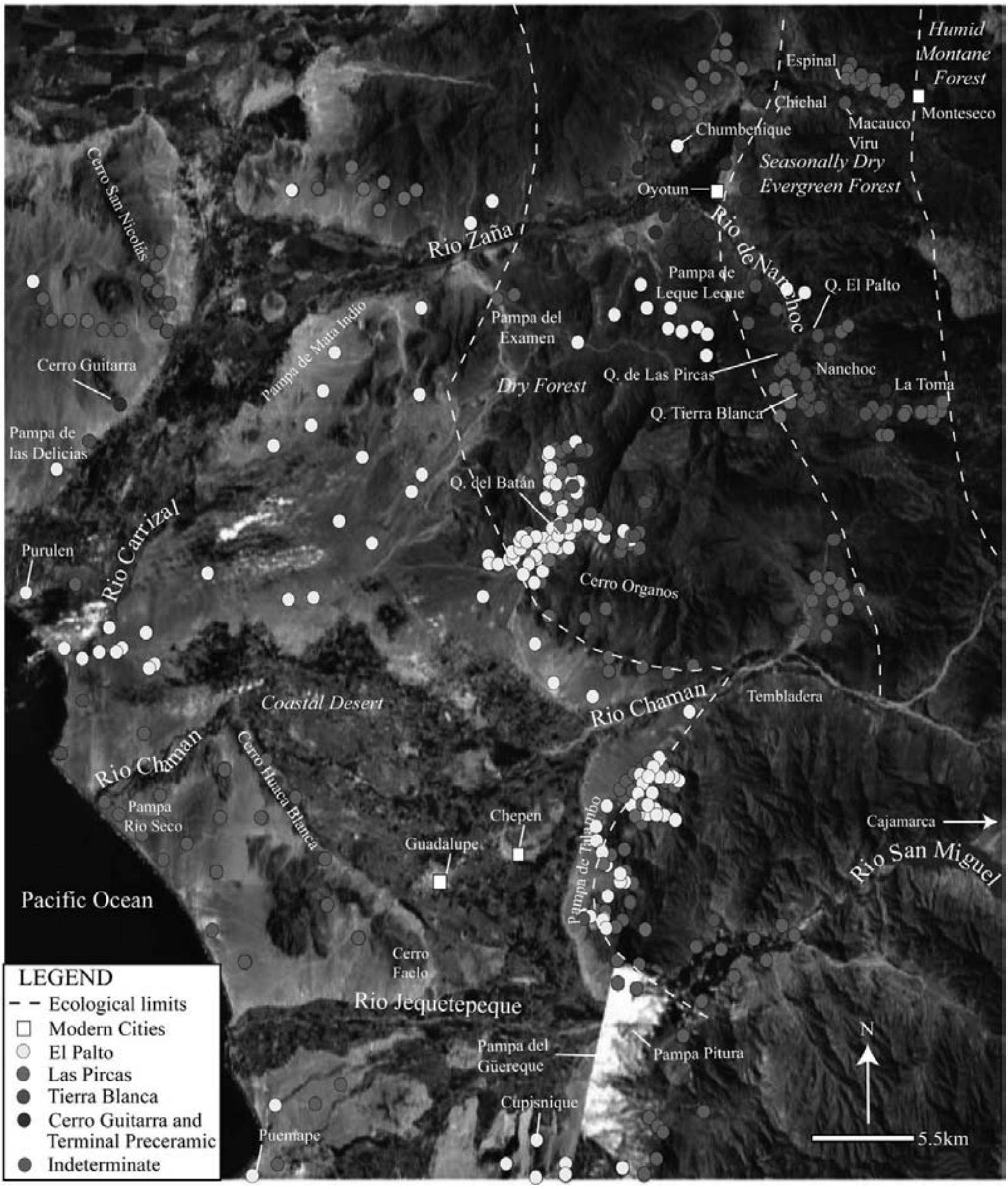


Figure 1.2. Satellite view of the lower Zaña and Jequetepeque valleys showing all Preceramic sites by phases across different ecological zones.

returned to a foraging strategy, or they aggregated and disaggregated in and out of sedentary communities (e.g., Kennett and Winterhalder 2006; Barker 2006; Grove 2009). Some foragers even managed plant and animal resources by fostering environmental conditions that promoted preferred foods, such as palm nuts in the Amazon rainforest and shellfish along

the Pacific coast of South America. And some complex foragers were "domesticated" in the sense that they constructed monumental architecture and residential spaces that mirrored an asserted cultural ethos separate from but intertwined with the "natural" world (e.g., Wilson 1988; Hodder and Cessford 2004; Dillehay et al. 2007; McGovern et al. 2007; Mills 2007).

Taken together, new data and ideas have constituted a fundamental challenge to the way we think about early hunters and gatherers, the beginnings of simple and complex forager societies, plant food production and farming, social relations, and the contributions early societies made to later ones. Complex foraging systems now are thought to have differed from simple ones essentially in the degree and nature of social differentiation and in the content, use, and meaning of material items (Gamble 2004). We now understand that more complex societies institutionalized practices that served additional (and diverse) functions for their individual members and were organized as relatively specific entities in different places (Binford 1980; Ingold 1980; Rowley-Conwy 2001). These practices were ritual orders, social networks, technological traditions, perhaps gender-based units, and others, which were performed in specific private or public places, such as individual huts, charnel houses, and ceremonial centers. These places generated new social roles that were fluid with respect to emerging relations of power, identity, and memory with other groups. These changes generally involved a reduction in mobility and an increase in sedentism, storage, and resource rights associated with collected and harvested resources, and the development of different social values and conditions.

As a result of this new thinking, the firm boundaries that once defined early farmers and fishers apart from broad-spectrum foragers are being reconsidered (cf. Bar-Yosef and Meadow 1995; Dillehay et al. 2004; Scarre 2002). We now realize that complex foraging and farming societies oscillated through time and space in many parts of the world and that there was no inevitable progression from one stage to another for all societies. We also know that much variability existed in forager subsistence, demography, social structure, and ideology, with many transformations occurring at the community level defined by a mosaic of different contemporary economies and social structures. These findings, in turn, have encouraged a reexamination of the co-existing relationships between some early farmers and foragers, why some foragers built monuments and farmed part-time, how incipient mound building reflects the structure and organization of groups, and how the interrelationships between groups and various

"external" influences shaped local adaptations and historical trajectories (Fall et al. 2004; Fitzhugh and Habu 2002; Moore 1998).

Within this context, more emphasis has recently been placed on built landscapes, domestic architecture, special public places and symbols, plant domestication, and community patterning (e.g., Hodder 1990; Joyce and Gillespie 2000; Yaeger and Canuto 2003) and on the organizational implications of these elements within oscillating and transitioning societies. As Wilson has noted, "Domesticated society is founded on and dominated by the elementary and original structure, the building, which serves not just as shelter but as a diagram and, more generally as the source for metaphors of structure that make the social construction and reconstruction of reality possible" (Wilson 1988:153). The threshold between the domesticated and the nondomesticated was constantly negotiated and symbolized in such things as the treatment of the dead, the size and location of houses, the separation of public and private spaces, and people's "desire" to become less mobile (cf. Goody 1977). We now view the relations between people and their domesticated and nondomesticated environments in terms of a wide variety of concepts, such as "landscape" (Crumley 1993), "inscribed landscapes" (Thomas 1991), "contingent landscapes" (Barton et al. 2004), "landscape management" (Balée 1994), and "socionatural systems" (McGlade 1995), among others. These concepts imply, to various degrees, that landscapes were negotiated and constructed by interdependent social and natural processes that became the specific materialized settings defined by human actions (Bradley 2000; McGhee 1997).

This book considers not only the social and natural environments created through the actions of populations living in the Zana and Jequetepeque valleys in northwest Peru from the late Pleistocene to the middle Holocene period, but also the consequences of recurrent cycles of climatic and environmental change on the settlement, technological, and subsistence history of these populations. While at the outset of human history in this area, people may have been passive and adapting to existing environmental conditions, they eventually became active, creative social agents practicing a form of landscape management initially through broad-spectrum foraging and the beginnings of food production and later through community irrigation farming in selected areas. These processes eventually produced a "net environmental diversity [and economic potential] greater than that of the so-called pristine conditions with no human presence" (Balée 1994:116) and communities that created new social and economic venues that took some of the initial steps toward Andean civilization (Dillehay et al. 2008).

THE CENTRAL ANDEAN COASTAL PLAINS AND FOOTHILLS

Although much recent archaeological research has focused on the past cultural and environmental relations that led to complex societies in various parts of the world, little is still known about the specific intertwined social and natural systems that resulted in these changes in the Central Andes. Understanding these relations is important, because the Central Andes is one of the few areas in the world where the coalescence of maritime and inland foraging economies set in motion long-term biological and cultural processes that fostered social complexity and food production, and later the development of preindustrial states and urbanism (e.g., Bonavia 1991; Dillehay et al. 2004; Lanning 1963, 1967; Lavallee 2000; Moseley 1992).

Human society in northwestern Peru began more than 13,000 years ago, as evidenced by several early archaeological sites located on the dry coastal plains and the lower western slopes of the Andes. At this early date, it is difficult to speak about the type of society that existed. Different forms of social organization surely existed, as inferred from site location, size, and internal features. The fundamental data provide insights into the technology and economy of these people and how they interacted with the local environments (e.g., Briceño 2004; Dillehay et al. 2003, 2007; Maggard 2010; Richardson 1978). The key data were first provided by a long-term project directed by Claude Chauchat (1982, 1988; Chauchat et al. 1998, 2006), which focused on the Paiján culture in the Quebrada Cupisnique and the Chicama Valley and its early stone tool technologies and subsistence and settlement patterns. We can surmise that the Paiján people were generalized hunters and gatherers whose mobility allowed them to adapt to changing environmental challenges at the end of the Pleistocene period around 11000 BP. Between ~10500 and 8500 BP, early Holocene foragers continued many of the patterns that characterized the earlier period, although there were changes in the environment and in the technological, social, and economic organization (Dillehay et al. 2004, 2007; Maggard 2010). The first cultigens and household gardening also appeared during this period (Dillehay et al. 2008; Piperno and Dillehay 2008; Rossen 1991). Later, between ~8500 and 5000 BP, there is evidence for more complex foragers practicing a broad-spectrum economy in most parts of the study area, though farming, living in permanent houses, and building public works such as small mounds and irrigation canals developed in the dry montane forests of the Nanchoc Valley, a side branch of the larger Zaña Valley (Dillehay et al. 1989, 2007). Although mixed foraging and gardening economies existed from at least 9500 BP, intensified farming

was added after the innovation of canal irrigation around 6000 BP. This was not a revolution but a gradual transition or evolution. These changes and others from other regions of the Andes, especially the highlands, provided the foundations for the subsequent development of early Central Andean civilization (cf. Aldenderfer 2004; Bonavia 1991; Dillehay et al. 2004; Lavallee 2000; Stothert 1985, 1992).

More specifically for the Peruvian coast and adjacent Andean foothills, it was Lanning (1963, 1967), Patterson (1971), and Moseley (1975, 1992, 2005) who developed some of the first models to explain middle Holocene societies by focusing on socioeconomic changes among Preceramic populations on the central coast of Peru. Each of these models involved occupation of *lomas* (seasonally vegetated) formations, located some 3–5 km from the present-day coastline. Later Preceramic populations abandoned the *lomas* and shifted settlement to the littoral zone, increasing the intensity of maritime resource exploitation. This shift to maritime resources was thought to have resulted in the development of sedentism and later monumental architecture.

Though these general trends are part of each model, there are differences in the relevant mechanisms of change for each. For instance, Lanning (1963, 1967) suggested that environmental changes led to the disappearance of *lomas* plant species that were important to hunter-gatherer seasonal subsistence practices. Patterson (1971) argued that increasing population pressures led to the overexploitation of *lomas* during the Encanto phase (6800–5500 BP), thus forcing a shift in settlement and subsistence patterns. Moseley (1975) thought that Preceramic populations were drawn to the coast by the richness of the marine resources rather than being pushed there by environmental or demographic factors.

Lanning (1963, 1967) also suggested that labor organization was important for understanding early social complexity. Multiple, large nucleated centers (e.g., El Paraiso, La Florida) began to appear along the coast during the late Cotton Preceramic period. Lanning proposed that the architecture of these sites provides evidence of organized labor and planned supervised construction. Patterson (1971) later presented a four-factor model regarding the transition from a hunter-gatherer economic system to agriculture on the central coast: population changes, changes in the intensity of land use, movement of people and/or goods from place to place, and the location and permanency of settlement. By the end of the Encanto phase, coastal hunter-gatherers had shifted their settlements to incorporate marine resources, ultimately occupying lower valleys on a year-round basis. With sedentism, floodplain farming began to increase; the combination of

agriculture and maritime resources gradually led to the exclusion of wild resources in the diet. The increased intensity of cultivation and marine resource use was both the cause and consequence of population increases and changing settlement patterns of the late Cotton Preceramic.

Moseley (1975, 1992, 2005) placed greater emphasis on the role of maritime resources in the development of complexity. He suggested that rather than gradual inclusion of marine resources, rapid adoption of marine foods occurred during the late Cotton Preceramic, with only minimal inclusion of cultivated plants. Although he later downplayed the role of agriculture, Moseley (1975, 1992) recognized the growing interdependence of the two economies during the final Preceramic phase. He also suggested that the technological simplicity of maritime subsistence permitted more free time, which facilitated the development of social evolution (i.e., religion) and refinement of crafts and skills, ultimately resulting in social stratification. As the coastal population eventually increased, the limits of maritime subsistence were reached, resulting in the need to intensify agricultural practices, a change that was achieved through the development of irrigation agriculture farther inland. Recently, Moseley (2005) included new data in his model, particularly those relating to Preceramic sites with monumental architecture of the Supe Valley – most notably the Caral site (Shady 1997, 2005; Shady and Leyva 2003). He now recognizes the contribution of agriculture among late Preceramic populations of the coast, emphasizing that early plant husbandry was geared primarily toward the production of industrial species, such as cotton and gourd, from which fishing technologies (e.g., nets and floats) were produced. According to this view, crop production for sustenance was of secondary importance – thus maintaining the primacy of maritime economy as the basis for civilization. Moseley further noted that most cultigens among coastal dwellers were fruit trees, cotton shrubs, squash, and beans, which did not require constant care, thus permitting fisherfolk to devote most of their time to maritime endeavors while still pursuing minimal agricultural practices. Moseley envisioned two separate, symbiotic economic systems – maritime and agriculture–that were linked through co-dependent relations of exchange (Moseley 2005).

In summary, Lanning, Patterson, and Moseley argued the presence of aspects of social and economic complexity among Preceramic hunter-gatherers, fishers, and agriculturalists along the central coast of Peru. Their respective contributions guided other researchers to recognize the early roots of civilization that predated Chavín, which had long been considered the first complex society of the Central Andes (Tello 1930). Subsequent researchers (e.g., Benfer 1984, 1999; Bonavia 1982b; Dillehay et al. 1989;

Fung 1988; Kaulicke 1994, 1997; Lavallée et al. 1985; Pozorski and Pozorski 1987; Sandweiss et al. 1989, 1998b; Stothert 1985, 1992) expanded on these and other studies (e.g., Bird et al. 1985; Engel 1957; Kaulicke and Dillehay 1999a,b; Richardson 1969, 1973, 1978) – ultimately revealing new and different degrees of variability and antiquity in the transformative processes that led to early social complexity and food production.

This volume reviews the archaeological evidence that demonstrates these transformations in the Zaña and neighboring Jequetepeque valleys in northwest Peru from ~12000 to 5000 BP. Preceramic occupation of these valleys is represented by the development of different mobile to sedentary forager-fisher-farmer societies that saw major and minor environmental changes and the creation or adoption of a myriad of technological, social, subsistence, and settlement strategies. Social changes in behavioral and material traits occurred gradually, either having been invented or introduced, intensified, implemented, refined, and worked into local cultural systems over many generations. Although the beginnings of food production and sedentism took place earlier, the commitment to intensified crop production did not occur until ~6500 BP when agricultural fields and irrigation canals were constructed (Dillehay et al. 2004, 2007; Piperno and Dillehay 2008). However, a social commitment to cultivation and semisedentary to sedentary households occurred as early as 8500 to 8000 BP in the form of reorganized settlements and ritual systems (Dillehay et al. 1989; Rossen 1991). This commitment was the product of a set of decisions and responses that resulted in fundamental organization changes in society, increased risks, and uncertainties. Further, this commitment did not occur everywhere, and when it did, it was gradual and intermittent. Yet, in certain environmentally rich ecological zones, such as the seasonally dry forests on the lower western slopes of the Nanchoc Valley in the study area, these changes involved low-risk intensification (Rossen 1991). In other areas, such as the more arid lower elevated foothills and coastal plains to the west, higher risks were likely involved, which called for different social and economic strategies.

There were also major shifts in social and ritual roles that developed in coordination with sedentary communities and new agricultural technologies (Dillehay et al. 2007). These shifts are reflected in the change from circular to rectangular domestic structures and from individual household gardening to multi-household irrigation agriculture and in the appearance of public gatherings at small mounds. With public works expressed in the form of mounds and irrigation canals, there was an emphasis on increased community interaction. Investigating these developments in the

Zaña and Jequetepeque valleys is crucial to understanding the early origins and history of Andean civilization in one region. Themes arising from this history that are of wider comparative interest include but are not limited to these:

1. The first entry and dispersion of humans in northwest Peru, the appearance of a generalized foraging economy and domestic structures, and the establishment of a semisedentary lifeway.
2. The emergence of mixed foragers and gardeners and later farmers in the dry forests, and the adoption or invention of new technologies, such as plant domestication (e.g., coca, cotton) and irrigation farming on the way to becoming permanent farmers.
3. The different kinds of relationships that played out between hunter-gatherers and food producers (e.g., foragers, farmers, fishers).
4. The interplay between private and public places and their social meanings.
5. The appearance of settlement aggregation, communal architecture, intensive food production, and community development long before evidence for a village lifeway.
6. Crop intensification less tied to demographic pressure than to strategic development by a local community.
7. The unevenness of these developments across time and space.

These themes are studied from the perspectives of paleoenvironmental reconstructions, archaeological site excavation and survey results, models of socioculture change and adaptations, and information gained and exchanged among participating researchers over many decades. As discussed in later chapters, the overall conceptual approach is drawn from differing aspects of cultural ecology and interaction theory and from previous research in the region.

ENVIRONMENT AND BOUNDARY OF THE STUDY AREA

Today as in the prehistoric past, northwest Peru exists as a land of remarkable environmental and social contrasts. The area is often conceptualized as three regions: the Pacific littoral zone, the desert coastal plains, and the western slopes of the Andes (Fig. 1.2). From an archaeological and ethnographic standpoint, this modern geographical separation is largely meaningless because the indigenous cultural context cross-cuts all environmental zones. The arid coastal environment, for example, stretches from

Figure 1.3. View to the west from the coastal desert plains south of the Jequetepeque Valley. A stone-lined structure dating to the late Paiján subphase is present in the foreground (arrow).

the seashore to the lower Andean ranges and embraces widely varying conditions, including deserts, grasslands, and *algarrobo*, evergreen and deciduous dry forests (Figs. 1.3–1.4). In some high elevated areas of the Zaña Valley and Jequetepeque valleys, there are dry and humid forests, deep

Figure 1.4. View to the north of shrubs and grasses of the dry quebradas (alluvial fans) located in the foothills of the Andes between 20 to 40 km from the present-day coastline (arrows point to early Preceramic site locations).

gorges, and canyon lands (see Chapter 3 and Appendix 2 for more details; also Dillehay et al. 1989; Maggard 2010; Rossen 1991; Stackelbeck 2008).

The diversity of habitats in the region supported various animals, including deer, puma, peccary, bear, fox, felines, and several bird and reptile species. Important wild edible plants found in the area include cactus, plums, *algarrobo* pods, *pacay*, *zapote*, among others. Resident freshwater fish include perch, trout, and minnows, as well as crayfish. Marine species of economic utility included seaweeds, tuna, sea bass, mullet, shark, anchovy, sea lion, a wide variety of shellfish and water fowl, and others. Along the coast, the sea level rose more than ~20 m from the terminal Pleistocene to the middle Holocene period (e.g., Denton et al. 1999; Ortlieb 1989; Rein et al 2005; Richardson and Sandweiss 2006: see Chapter 3). The productivity of marine mammals, fish, and shellfish whose habitat was primarily the subtidal zone was increased during this period. Perhaps most significant is that the study area in northwest Peru offered a broad range of resources from marine organisms to a wide variety of flora and fauna in inland grassy and forested environments. As seen later, Preceramic human land use strategies incorporated a wide range of simultaneously overlapping and interdependent economic choices and practices.

This study covers an area of about ~3000 km^2 from the Zaña Valley in the north to the Chamán, and Jequetepeque valleys in the south (Fig. 1.2). These three rivers flow east to west descending the western slopes of the Andes and bisecting the coastal plain before they empty into the Pacific Ocean. Two major branches comprise the headwaters of the Zaña River, the primary and northern Zaña branch and the southern Nanchoc branch. Today, these branches are characterized by a seasonally dry forest (500–1,200 masl [meters above sea level]) and a higher elevated, dense humid montane forest (the Taulis and Monteseco forests between 1,700 and 2,600 masl) that opens into a highland basin or *bolson* (Fig. 1.5); the latter branch is also defined by a tall, spectacular seasonal waterfall. Moving south, the Chamán River is smaller and less vegetated; it is often considered part of the Jequetepeque Valley to the immediate south. The upper portion of the Jequetepeque Valley is defined by two drainages descending the lower slopes of the Andes: the Jequetepeque and San Miguel rivers flowing from the Cajamarca basin in the highlands to the east. The upper sector of the Jequetepeque Valley does not have a forested pocket or open basin today. In all of these valleys, the climate and environment become more arid and much less vegetated as one proceeds east to west, although the littoral zone is cooler and more humid.

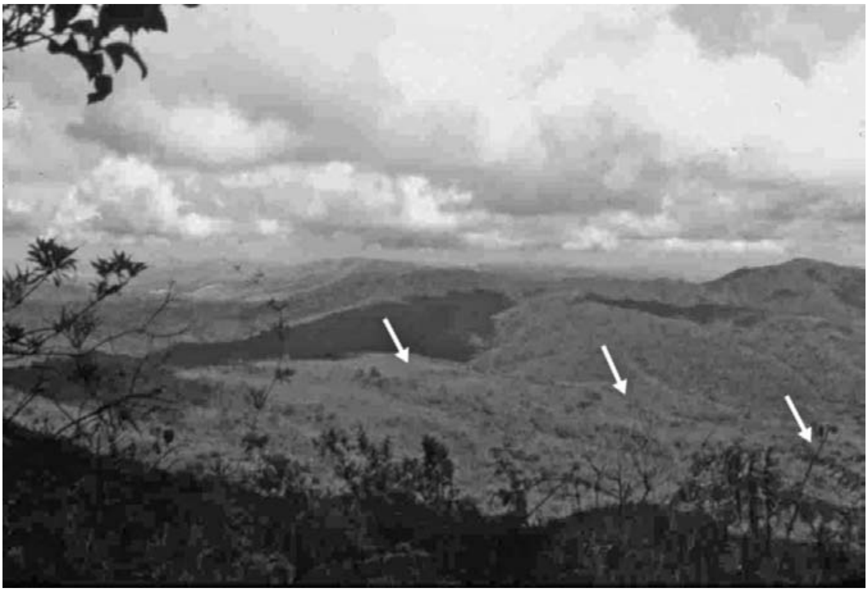


Figure 1.5. View of the humid tropical forest in the upper Zaña Valley (arrows show the location of early sites).

The northern boundary of the study area lies ~5 km north of the Zaña River, and ~60 km east of the Pacific Ocean near the highland areas of Udima, La Toma, and Niepos (Fig. 1.1). The Andean mountains at ~3000 masl are its eastern limit; Puemape on the coast and Quebradas (Q.) Pitura, Güereque, and Cupisnique, located ~10 to 15 km south of the Jequetepeque River, make up its southern fringe. Tributaries of the Zaña, Chamán, and Jequetepeque rivers drain the Andean mountains to the east. Today, the lowland areas of these drainages are primarily populated by desert vegetation and by cactus, shrub steppe, and steppe habitat, while the higher elevations in the eastern part are covered by xeric thorn, and dry and humid montane forests (see Chapter 3).

Although regional climatic reconstructions for the time period under study have been published (see Richardson and Sandweiss 2006; Wells 1987, 1990; Weng et al. 2006), it is important to note that each of these reconstructions is unique, often covering different periods, using different proxy data, and agreeing and disagreeing on various interpretative issues. It is now apparent that biotic evidence taken from different locations within northern Peru but in relatively close proximity to one another often suggests different climatic contexts. The primary evidence used as a proxy for climatic change comes in the form of plant and animal identification at specific times in specific depositional environments. These

proxy data are gathered from archaeological sites and geological contexts such as trash middens, springs, lake cores, and so forth. Unfortunately, this evidence is often specific to isolated locations and cannot easily be extrapolated to wider settings. Nonetheless, the paleoclimatic and paleoenvironmental research indicate that the late Pleistocene to middle Holocene period was marked by continuous changes in environment generated by the changing climate, sea level, and other conditions, as discussed further in Chapter 3.

We also must caution that environmental changes do not necessarily always have an impact on human populations. It is possible that some changes resulted in a certain degree of resource stress or greater availability/diversity at different times, especially during the marked changes from the late Pleistocene to early Holocene period. For example, in the Nanchoc area of the upper middle Zaña Valley, there is little substantial evidence to indicate any prolonged impact either on resource stress or availability due to environmental changes. In this regard, there seems to be a paradox in the archaeological and paleoecological data. In parts of the study area, there is evidence for increased arid conditions and possibly resource stress between ~8800 and 6500 BP. Yet, it was during this same period that people adopted cultigens, became less mobile and eventually more sedentary, and built mounds and irrigation canals in the least environmentally stressed and continuously more humid portions of the Nanchoc basin. As noted earlier, these cultural changes not only represent complex foraging, settlement aggregation, and incipient to intensive farming but the initial pulses toward Andean civilization. How do we explain this paradox? Are environmental, social, or other factors most accountable for the appearance of these features during presumed times of climatic and resource stress? Or perhaps the proxy paleoclimatic records are not precise enough for this period and the climate was not so arid but more temperate and accommodating in some places? Or might we instead expect social and subsistence intensification to occur under richer ecological conditions instead of resource stress (Harris 1977)? We attempt to answer these questions later.

Last, as the early archaeological and paleoenvironmental records are presented, we refer sometimes to the entire study area and at other times to specific drainages. We also draw on information from specific drainages and particular sites to make interpretations about the entire area. However, the specificity for which such interpretations can be made will vary from location to location based on the extent to which we can rely on the accuracy of our paleoecological and archaeological knowledge.

Chronological Scheme of Phases in the Study Area*

Phase	Time Period
El Palto	13,800-9800 BP
Early Paiján subphase	13,000-11,200 BP
Late Paiján subphase	11,200-9800 BP
Las Pircas	9800-7800 BP
Tierra Blanca	7800-5000 BP
Terminal Preceramic Period	5000-4500 BP
Initial Period	4500-3500 BP

*Based on calibrated radiocarbon dates.

Figure 1.6. Chronological scheme of the Preceramic and Initial periods in the study area.

CULTURAL PHASE CHRONOLOGY

In establishing a chronology for the beginnings of human history and cultural developments in the project area, we have defined three phases and two subphases based on more than ninety conventional and AMS (accelerator mass spectrometry) radiocarbon dates from charcoal and bone derived from stratigraphically excavated hearths and other features. These features were present in intact floors of hut structures, buried use surfaces, and general midden zones at thirty-seven excavated sites. Our strategy was simply to plot the oldest and youngest acceptable dates at a two sigma confidence interval, and then to examine the presence or absence and, as appropriate, degree of overlap in ranges. We rejected dates with extremely high uncalibrated error ranges (greater than 250 years), although they are listed in Appendix 1. The latter had little impact on the analysis as the error ranges of nearly all sites lie in the 100 to 200 radiocarbon year range. Finally, all calibrations were conducted using the Calib 4.3 program (Stuiver and Reimer 1993) for the southern hemisphere.

The phase names follow those of quebradas (alluvial fans or large drainages) in the Nanchoc Valley where the first excavations were carried out in the early 1980s. Results of the radiocarbon dating are interpreted as follows (see Fig. 1.6 for the chronological scheme of the phases and subphases in the study area). First, the El Palto phase overlaps with the late Pleistocene and early Holocene periods and dates between ~13800 and 9800 BP. The earliest part of this phase is based on a single radiocarbon date from a stratified, intact deposit with unifacial tools at the El Palto site in the Nanchoc Valley and on the presence of diagnostic Fishtail and Paiján projectile points at a few radiocarbon dated sites in the Quebrada (Q.)

del Batán and Q. Pitura and of Amotape- and Siches-like flake tools in the Carrizal drainage near the ancient delta of the Zaña Valley. The latter part of the phase is divided into the early Paiján subphase (~11700–10800 BP) and the late Paiján subphase (~10800–9800 BP). As discussed later, these two subphases are defined on the basis of distinct types of Paiján points, the absence or presence of small house structures, respectively, and a generalized foraging lifeway (Dillehay et al. 2004; Maggard 2010). Second, the span of dates representing the Las Pircas phase (~9800–7800 BP) is from several sites in the Q. Pircas in the Nanchoc Valley (Dillehay et al. 1989; Rossen 1991) and a few sites situated in the Q. del Batán and Q. Talambo (Stackelback 2008). The Las Pircas phase is characterized primarily by circular houses, an economy of primarily cultigens and a few species of wild resources, and small mounds. The Tierra Blanca phase (~7800–5000 BP) is associated with sites primarily located in the Nanchoc Valley and the Q. Talambo. This phase is defined by small mounds, rectangular houses, irrigation canals and agricultural fields, a wide array of cultigens, and a few wild plants and animals. Because the defining traits of the Las Pircas and Tierra Blanca phases are best represented in the Nanchoc Valley, we have collectively referred to them as the Nanchoc Tradition (Dillehay et al. 1997). The current data support a general occupational abandonment of the Nanchoc basin and perhaps other quebradas after ~5000 BP, and a movement of farmers farther downvalley where larger tracts of cultivable lands were available (Dillehay et al. 1989). Lower elevated quebradas near the coastal plains were continuously occupied by mixed foragers and incipient farmers, however.

Last, a problem with these phases is how they are represented across the entire study area. There are some subareas where the defining traits of each phase are not present, suggesting that they were never adopted or that those traits are not archaeologically visible due to modern-day destruction of sites, to deeply buried and thus invisible cultural deposits, and/or to other reasons. For example, there are large tracts of the study area where there is no evidence of the El Palto phase (see Chapter 4). Further, in the Q. del Batán and Q. Talambo, there are a few canals and houses typical of the Tierra Blanca phase, but there are no mounds and no botanical evidence of agriculture like those documented in the Nanchoc Valley (see Chapter 6). More than 200 sites exhibit nondiagnostic lithics and other artifacts and thus classified as indeterminate. Many of these sites appear to be multicomponent locales, thus making it more difficult to classify them.

SETTING THE STAGE IN THE STUDY AREA

To set the stage for consideration of some concepts that can best explain the archaeological findings, we briefly review the history of the cultural phases that have been constructed to date by the project and presented in various publications and doctoral theses (numerous articles and book chapters by Dillehay, Rossen, Netherly, Stackelbeck, and Maggard; see the references cited). This knowledge helps guide us toward relevant patterns and questions directly related to both the old and new data at hand.

Archaeology cannot provide a precise answer about the timing of the first human settlement in the Central Andes and more specifically the north coast of Peru, because many regions remain to be explored and better dated by radiocarbon means. During the foundation era of initial colonization, the human population was probably very small and may not have left sufficient traces to be archaeologically visible in some landscapes. Given the presence of humans before 14,000 years ago at sites in other parts of the continent (Dillehay 2000a,b), it is probable that people arrived in northwest Peru before 13,000 years ago and the earliest archaeological traces presently recorded by Fishtail and Paiján points of the El Palto phase (cf. Briceño 2004; Chauchat 1988, 1998; León 2007; Maggard 2010). It is also probable that earlier sites exist along the now submerged littoral zones of the continental shelf that are approximately 20 km away west of the present-day shoreline.

As noted previously (Chauchat et al. 2004; Dillehay et al. 2004; León 2007; Maggard 2010), regional and local variation in early unifacial and diagnostic Fishtail and Paiján stone tools and the use of local raw lithic material suggest constriction of local territories during this phase. We regard these patterns as being indicative of localized or territorial foraging and even semisedentism in some areas during the latter part of this phase, especially in the Nanchoc, Q. del Batán, Q. Talambo, and Q. Cupisnique areas where the greatest density of early sites is found (Fig. 1.2). Domesticated squash (*Cucurbita moschata*) was adopted by late Paiján people in the Nanchoc area. The constriction of territory, reduced mobility, and localization of population continued and accelerated past ~10,000 years ago into the Nanchoc Tradition (e.g., Las Pircas and Tierra Blanca phases; Dillehay et al. 1995).

In some areas, this pattern of resource exploitation began to change rapidly between ~9,700 and 7,800 years ago. For instance, in the Nanchoc Valley between ~900 and 2,000 m above sea level, where now relict

seasonally dry forests were exploited as far back as 12,000 years ago, hunters and gatherers began a local permanent or sedentary life during the late Las Pircas phase (~9000–7800 BP) with small organized settlements, specialized treatment of the dead, domestic circular houses, house gardens, and subtle social differences. The technology was dominated by unifacial tools, a varied ground stone technology, simple food storage, and a food economy based primarily on crops and secondarily on wild plants and animals. Late Las Pircas sites yielded cultivated squash, peanut, manioc, a quinoa-like chenopod, *pacay*, and several unidentified wild fruits (Piperno and Dillehay 2008). Low frequencies of exotic materials (e.g., marine shell, carved stingray spines, quartz crystals, and raw stone material) suggest minor contact with distant coastal and highland areas. Initial construction of two small earthen mounds at the Cementerio de Nanchoc site (CA-09–04) occurred at the end of this phase.

The following Tierra Blanca phase (~7800–5000 BP) was marked by changes in settlement pattern with people aggregating closer to the valley floor and its fertile soils, by house styles shifting from small elliptical to larger, multiple room rectangular structures, by the addition of cultivated cotton, beans, and coca, and by the construction of an artificial agricultural system associated with irrigation canals. Although exotics seem to have disappeared, the separation of public and private space was pronounced as evidenced by converting the two small earthen mounds at CA-09–04 to larger dual, stone-faced, multitiered structures where lime was produced in a controlled, presumed ritual context for use with coca leaves (Dillehay et al. 2010). During this phase, the coastline was stabilized and the first evidence for maritime foragers appears in the form of shell midden sites. Similar and dissimilar phase patterns are broadly represented across other drainages in the study area, especially the Q. del Batán and Q. Talambo. It is clear that between ~9,000 and 5,000 years ago, substantial semisedentary to sedentary and highly localized settlements, broad-spectrum foraging, incipient to intensive agriculture, and diverse patterns of land use came to characterize the Zaña and Jequetepeque valleys.

Perhaps some of the most apparent changes were shifts in the lithic technology and the treatment of the dead between the Las Pircas and the Tierra Blanca phases, along with the movement of ritual from individual households to the public context at the CA-09–04 site. This shift coincided with the additional building and elaboration of the two Nanchoc mounds, suggesting a change from individualized household accumulation, aggrandizement, and perhaps competition to public or communal concerns, in this case the production of coca and lime for local and possibly distant use

(Dillehay et al. 2010). We suspect that the impact of this separation was to create a special place that served the local community for many generations as a communal and continuing focus for public ritual. Of further interest is the interrelationship between the two mounds and the organization of the society that built them. The labor requirements to build the mounds likely represent the periodic products of a small kin-based group of local households. There is no evidence to suggest that formal leadership and corporate labor had emerged during the study period.

We also have considered the social and economic foundations of the Preceramic societies under study here to be the *proto-household* during the El Palto phase, the *household* during the Las Pircas, and *multiple households* during the Tierra Blanca phases. We have previously followed Bogucki's (1999) distinction among these basic units of production by relating the former to foragers and the latter two to horticulturalists and agriculturalists, respectively (Dillehay et al. 2003); the distinction lies in the degree of permanency and the multitude and intensity of economic activities associated with each. Proto-households operated on a seasonal or nearly year-round basis and associated with fewer and less intense activities, as suggested by the relatively low to moderate portion and diversity of artifacts and the presence of a few hearths and generally thin and intermittent floor deposits. Houses are larger, have thicker and continuous floor deposits, and are associated with a greater number and diversity of tools and hearths and other features. In this study, we attempt to explain the replacement of proto-households by households, discuss how extensive this replacement pattern was, what it tells us about Preceramic settlement systems, whether this change represents a new adaptive strategy adopted by extant groups, and whether it represent shifts in the social structure and relation between local groups. Multi-households is more an expression of settlement and community patterning whereby households begin to aggregate but also shift from round houses during the Las Pircas phase to rectangular houses during the subsequent Tierra Blanca phase.

In summary, the long history of Preceramic people in the Zaña and Jequetepeque valleys is presented by generalized foragers, specialized maritime gatherers and hunters, incipient foragers and garden horticulturalists, and intensive farmers in a wide variety of environmental contexts between ~12000 and 5000 BP. These diverse economies entailed different degrees of technological innovation, planning, risk management, resource sharing, mobility, territoriality, sedentism, and social interaction. In addition to reconstructing and explaining these developments, there are several specific questions to resolve. For example, how do we explain the initial

peopling of the study area? Why are there habitats where the environmental conditions were suitable for cultivation and sedentism but there is no evidence for an even and widespread development of agriculture and public works? That is, although cultivation began in the seasonally dry forests of the Nanchoc Valley and then shifted gradually downward to the main floor of the Zaña Valley, it did not spread to all suitable habitats in the study area during the late Las Pircas and Tierra Blanca phases? Why was agriculture not developed immediately by all valley inhabitants? What were the relative roles of environmental, technological, and ideological factors in the local development of garden horticulture and later irrigation agriculture? Could specific locations holding sedentary peoples have been abandoned for more productive locations as micro-environments changed because of natural and human perturbations? To what extent was population aggregation related to multi-household community formation during the Tierra Blanca phase? How might this be related to the emergence of food intensification, social conflict, exchange, and the appearance of public works during this phase? Do these different but contemporaneous levels of societies (i.e., foragers, farmers, mixed foragers and farmers) represent a heterarchical development of relations between different subareas to one another whereby each possessed the potential for social and economic growth and for interacting in a number of ways? In other words, did heterarchical interaction exist where there were many different axes along which differentiation and transformation took place, rather than continuous development in one place, such as the Nanchoc Valley? Also important to consider is the broader meaning of the Nanchoc mounds to local people in terms of identity, social memory, and special built places on the landscape. These and the questions raised earlier are important to understanding culture change and social transformations not only for the study area but for a wider anthropological and Andean audience.

SOME GUIDING CONCEPTUAL ISSUES

Several conceptual models can be proposed to account for the first hunter-gatherers in northern Peru, including human entry routes that followed the coast and/or the Andean mountains, slow-tracking and fast-tracking population movements, generalized and specialized economies, and migrants and colonizers (e.g., Rossen and Dillehay 1999). For the moment, the most parsimonious approach is to surmise that only basic hunter-gatherer adaptations were the prerequisite for continent-wide and local settlement, and that colonization of different habitats required only adaption by degree

(e.g., Dillehay 2000a; Dixon 1999; Meltzer 2009). There are three key elements involved here. The first is that colonization of a new habitat, including the littoral zone and desert plains of the coast and the forested slopes of the western Andes, required neither profound cultural innovation, nor optimum extraction of resources, nor even a large population. Second, the greater the degree of local adaptation to one kind of environment, the slower would be the process of colonizing different habitats. More mobile and dispersed people, perhaps represented by the makers of the Fishtail points, were more likely to cross environmental boundaries and outpace a highly adapted, territorially focused group, such as specialized littoral-dwelling foragers as perhaps represented by unifacial sites in the lower Zaña Valley, or inland coastal plain settlers as perhaps represented by early Paíjan sites. And third, although fast-pacers were likely to produce more archaeological sites, they were probably small sites with a restricted number of tools and debris left behind. Slow-pacers probably produced fewer but larger and more diversified sites.

A starting point for consideration of the settlement, type, and internal structure of sites representing the hunter-gatherer or forager mobility and semisedentism of the El Palto to early Las Pircas phases is the organizational model provided by Binford (1980, 2001). He divides hunter-gatherer organizational movements into foraging residential mobility and collector logistical mobility. In foraging residential organization, hunter-gatherers are immediate consumers and move to food resources. Residential moves are scheduled to correspond with the seasonal or year-round availability of resources. In general, residential bases are thought to have been relatively large, containing evidence for more substantial occupation such as houses and storage, for a greater diversity of activities and resources and for artifact manufacturing, and sometimes serving as the locus of ritual and social interaction. In logistical organization resources are collected and moved to consumers via specialized task groups and usually stored for delayed consumption; storage facilities at logistical sites are often used much more intensively. Logistical sites, by contrast, are expected to be smaller and more specialized in both activities and resources, with little evidence of artifact manufacturing but considerable evidence of nonlocal materials brought in, and to have few nonsubsistence activities. Logistical mobility also posits the highly structured use of a diverse landscape by a hunter-gatherer group. When two or more types of contemporaneous sites exist with clearly different archaeological features that indicate different, usually specialized activities, this provides an indication that the group was logistically organized.

Operationalizing Binford's model requires recognition that residential and logistical strategies are a continuum and that many groups probably utilized both strategies, either seasonally or simultaneously (cf. Dillehay et al. 1997). Within this model, however, the assignment of a group to a particular point or range in this continuum describes or implies little about the way in which social relations (e.g., decision making, organization of labor and specialized task groups, sharing networks) and ideological foundations (e.g., belief systems, symbols) operated to acquire, distribute, and consume resources and to locate and organize sites. Although individual cases of residential foragers and logistical collectors seemed to have existed at various times in the study area (cf. Maggard 2010; Stackelbeck 1008), the most characteristic pattern seems to be a combination of these two strategies, with most emphasis on logistical modes ranging from low mobility to semisedentism especially in the late El Palto and early Las Pircas phases.

Smith (2001), on the other hand, deals with hunter-gatherer and farmer variability by presenting a continuum from "pure" hunters-gatherers to agriculturalists. He separates the continuum between food-procuring hunters and gatherers and food-producing farmers. He further divides food producing into three types: low-level producers without domesticates, low-level producers with domesticates, and agriculturalists. Societies may shift back and forth between these different levels through time and space. Although not all of these possible ranges (and many others not yet identified in the ethnographic record) have been recorded archaeologically, recognition of low-level producers with and without domesticates is a useful dichotomy for our study of contemporaneous foragers, with and without domesticates, and farmers of the late Las Pircas and Tierra Blanca phases.

The traditional approach in the Andes is to assume that substantial settlements with thick, continuous middens, occasionally house structures, and a few traces of cultigens (and/or ceramics) are nascent agricultural communities. Although there is evidence of several cultivars in the northern Neotropics of South America by at least 10000 BP (e.g., squash: Piperno 2007; see Chapter 14), nowhere is there currently any hard evidence for any form of intensified agricultural food production (as opposed to plant resource management or low-level production) before 7000 BP. This is significant, given that squash, beans, peanuts, and other crops were domesticated by at least 9000 to 8000 BP. Why it took so long for farming to spread from one region to another and to shift from low-level to high-level or intensified farming is not currently understood. Possible reasons could include forager resistance, environmental stress and change, including

latitude and altitude differences that prevented the adaptation of plants to new zones, or sampling bias in the archaeological record.

Relevant to this discussion is the term *complex hunters-gatherers*, which has been defined in large part on a set of co-occurring traits, including high degree of permanence or sedentism; high population density; storage; intensive economies with differentials of wealth, prestige, status, and possibly stratification; and a relatively advanced social system (Chapman 2003; Hayden 2001; Price 1981, 1995). Archaeologists often assume that residential sedentism can be recognized in the archaeological record by the presence of house structures because houses are conceptually linked to increased sedentism and a more collector-like economic strategy (Binford 1980). There are other archaeological indicators of increased sedentism, such as well-developed midden deposits and nonportable technologies such as ground stone. Rowley-Conwy (2001), on the other hand, dissociates sedentism from increased complexity and irreversible development, believing that hunters and gatherers can move in and out of reduced mobility and sedentism. Cross-cultural studies also have demonstrated that storage and delayed returns (e.g., Woodburn 1980) have a particular importance for those groups that stay in a single location for longer than five months (Kelly 1995; Arnold 1996a,b). These considerations are not explanations for the appearance of complexity, but rather recognition of some necessary preexisting conditions, such as low residential mobility, for complexity to develop.

Recent discussions also have been concerned with the social aspects of a foraging lifeway, emphasizing that mobility is not only a strategy that ameliorates the effects of spatial/temporal environmental variability but is also important in maintaining social networks and economic information (Casmir and Rao 1992; Crothers 2004; Gamble 1991; Kelly 1995, 1998; Wiessner 1982). Hunter-gatherer behaviors and social strategies can also be quite varied within the same environmental setting Kelly 1995; Kim 2003). Sharing among and within forager groups can also be seen not only as an adaptive behavior to increase fitness of individuals and groups but also sometimes as an intentional strategy of donors to create debt relationships, which can produce social inequality in the long run (e.g., Gosden 1989). These and other recent studies thus identify forager behaviors as not simply responses to the natural environment but also as strategic social choices among a variety of feasible options in which complex intersocietal relations are critical variables.

Binford (2001) takes a regional interaction approach to complexity, arguing that small, egalitarian groups can be integrated into larger, more

complex economic and social groups operating at regional scales through such institutions as exchange, production specialization, alliances, and so forth. He believes complexity develops when hunter-gatherer groups are initially dependent on plant resources more than others, which requires a logistical mode of organization. This view is important to our study, because it provides a regional-level approach that involves the simultaneous interaction of different social and economic systems, including mobile hunters and gatherers, broad-spectrum foragers, incipient farmers, and mixed foragers/farmers. Binford also suggests that once groups cross a demographic "packing threshold" in a particular environment, they begin experimenting with a wide range of organizational and technological solutions to offset resource stress caused by population pressure. Groups below the threshold respond to environmental and social stress by increased mobility. Groups above it rely on other organizational and technological changes, such as the intensification of food production or the adoption of agriculture to resolve increasing resource constraints. As we envision this scenario, a paradox in these regional level models, however, is that the actual development of plant cultivation may occur in the zone of greatest environmental richness and lowest risk, which, as presented later, is the case in the Zaña and Jequetepeque valleys. Low risk implies that if agriculture turned out to be unproductive, people could have switched back to foraging in the dry and humid forests of the Nanchoc Valley.

Infrequently considered in discussions of complex hunter-gatherers and early horticulturalists in the New World are the ideological dimensions of these societies. We view the Las Pircas phase pattern of ritual activity, or the development of household rituals and their accompanying reorganized social relations and technologies, as factors in the initial development of plant cultivation in the study area. During the following Tierra Blanca phase, the construction, composition, and association of various small mounds at CA-09–04 and other localities in the Zaña and Nanchoc valleys are intriguing, but it is the past meaning of these structures that also captures our interest. In line with the present-day interest in landscape and place identity, we can situate the earthen mounds at CA-09–04 within a larger context, seeking to understand their cultural context and meaning in addition to their morphology. Because the CA-09–04 mounds are not associated with habitation debris but with a specialized technology for lime production, we perceive them as associated with ritual gathering and a community identity beyond the household level (Dillehay et al. 1989; Dillehay et al. 2001). This interpretation likens the landscape with the

acquisition and production of lime for use with the consumption of coca (Dillehay et al. 2010).

Our initial interpretations of the overall database has not changed; however, armed with more data we now can relate the mounds not just to ritual but to social memory and place identity of intensive farmers and developing communities (see Chapters 13 and 15). In this regard, we follow the thinking of several scholars who envision a congruence between early monuments and early complex foraging groups who also practiced agriculture (e.g., Bender 1978; Sassaman 2008; Scarre 2002; Sherratt 1990).

Not discussed in detail are several topics that may be directly or indirectly related to the themes of this book. For instance, we do not review the literature on the origins of agriculture and its presumed rapid distribution because we are not dealing with the study area as a center or place of the invention and dispersion of crop domestication. Domesticates from other regions of South America were gradually incorporated into the diet of foragers and farmers in the area. However, it is unlikely that any of the early cultivars discussed for the Zaña and Jequetepeque valleys were first domesticated in northwest Peru. With the possible exception of cotton, the wild progenitors of all other plants are not found in this area (Dillehay et al. 2008; Piperno and Dillehay 2008). The precise routes through which domesticates were brought to coastal Peru has long been a topic of speculation but can be linked with increasing confidence to the expansion of late Pleistocene and early Holocene activity in the neotropical zones of northern South America, and along the eastern flanks of the Peruvian and Bolivian Andes (see Chapters 9 and 14: Hastorf 1999; Pearsall 2003; Piperno 2007). As discussed later, by at least 7000 BP, farming practices in the study area made use of fully domestic cultivars and employed some means of enhancing the productivity of soil, whether through irrigation, hoeing, flood control, or land clearance. In later chapters (13–15), we consider the relevance of these findings to broader discussions considering the adoption of crops, including models of diet breadth and habitat selection (e.g., Barker 2006; Kennett and Winterhalder 2006; Richerson and Boyd 2000), although our thinking related to these approaches is partially expressed at the outset of this chapter.

Furthermore, we do not apply the popular models of human behavioral ecology, optimal foraging theory, and cost-return ratios (e.g., Winterhalder and Smith 1992) to our database. We view these models as too hypothetical, too mechanistically dependent on patterns and distributions of economic resources, and too difficult to document and test archaeologically in

our study area where there are at least ten to twelve closely juxtaposed and often overlapping resource zones. Further, it is nearly impossible to reconstruct past cost and return equations for so many resource zones that are largely undefined for and changing throughout the late Pleistocene to middle Holocene periods. More recent versions of this model have attempted to study the variables that impact the optimality in these strategies (e.g., Kennett and Winterhalder 2006). But in order to employ this model, subsistence resources must be ranked based on their net caloric returns and empirically evaluated across multiple resource settings and archaeological sites through time and space. In this case, it is important to determine precisely the rank order of resources hypothetically available to past populations in different habitats, and the variable use of resources attested archaeologically through both time and space. In one of the most complete analyses to date of past resource utilization in the Nanchoc portion of the study area, Rossen (1991) did not utilize optimal foraying theory as a framework for studying differences in the processes and timing of resource use. Instead, he used diet-breadth and risk-reduction models to consider the relative return rates for foraging activity in a specific environmental setting. Undoubtedly, both mobility and diet choices played important roles in the processes whereby early hunter-gatherers developed broad-spectrum diets and later added cultigens to their diet and became increasingly reliant upon them. But human behavior is more than adding up the calories and costs/benefits of different economic strategies; social and other factors also must be taken into account.

Finally, this book draws on several of the above approaches to bring together archaeological and paleoenvironmental records. These are analyzed primarily within an interaction-based framework to explore the changing adaptations of localized and increasingly aggregated proto-household to multiple household communities and their complex foraging and agricultural subsistence systems, operating within a climatically shifting environment. In these systems, small-scale local processes in aggregate result in larger-scale regional outcomes. Although environmental change can have a significant effect on many aspects of these systems, especially from the late Pleistocene to the early Holocene period, it is by no means the only or even dominant factor. People themselves also impacted the environment and altered social choices and practices among themselves. The two-way interaction between people and the environment resulted in a complex array of co-transforming pathways and nonlinear responses through time and space (Barton et al. 2004; McGlade 1995; van der Leew and Redman 2002).

CLARIFICATIONS AND THE BOOK'S ORGANIZATION

The majority of the archaeological data presented in this book are available in research articles, technical reports, and doctoral dissertations. In addition to providing a synopsis of these data here, we also present new and unpublished data and, for the first time, an interpretative synthesis of all interdisciplinary information produced by all projects over the past thirty years. At the risk of producing an over-weighty volume, we decided to limit the details of the data and interpretations. We also have tried to guide readers through a long and complex narrative spanning 8,000 years by providing numerous headings and subheadings in chapters that we hope will help them identify the sections of greatest interest to them.

Chapters 2 and 3 respectively provide a more extended discussion of the environmental and cultural historical frameworks of this analysis. The chronological narrative begins in Chapter 4, which places the first presence of humans and their dispersion in the study area within a brief consideration of the first South Americans. This chapter specifically focuses on the El Palto phase. Chapter 5 presents the data for the Las Pircas phase. Chapter 6 discusses the Tierra Blanca phase. Chapter 7 is given to special public places and hillside village sites. Chapter 8 focuses on human remains from all periods. Chapter 9 presents changing subsistence economies over time by presenting the floral evidence, including cultigens. Chapter 10 presents the faunal evidence. Chapter 11 presents special technologies of the time span under consideration, including domestic structures, mounds, irrigation canals, among others. Chapter 12 evaluates the changing settlement and land use patterns. Chapter 13 examines the transition from foraging to farming. Chapter 14 sets the early food production of the study area within a broad conceptual and global framework. Chapter 15 presents interpretative models and conclusions.

CHAPTER TWO

Research History, Methods, and Site Types

Tom D. Dillehay, Kary Stackelbeck, Jack Rossen, and Greg Maggard

Our long-term research goals in the Zaña and Jequetepeque valleys were aimed at addressing several general questions discussed in Chapter 1. Initially, the project in the Zaña Valley was concerned with site discovery, chronology, and the study of the late ceramic occupation (Dillehay et al. 1989; Netherly and Dillehay 1985). Research in recent years has focused largely on the interplay of early settlement patterns, broad-spectrum foraging systems, community development, agricultural productivity, and emerging complexity in both valleys. Subsistence data, when gathered in tandem with settlement data, have provided information regarding early foraging and agricultural systems and the changing organization of food production over time and space.

More specifically, the Zaña-Niepos-Udima Project in the middle and upper Zaña Valley was initiated by Netherly and Dillehay in 1976 for the purpose of investigating the presence of a tropical montane forest and an Inca occupation in the Nanchoc Valley, the southern tributary of the former. Netherly had discovered a Spanish account in an early chronicle that mentioned the presence of an Inca *tambo* (Nanchoc) in the forested Nanchoc area. Upon initial investigation of the area, we discovered the presence of the dense dry and humid forests and a large number of Preceramic and Formative sites. The presence of these sites broadened our interest in examining long-term culture change through successive pre-Hispanic and Hispanic occupations. Between 1977 and 1997, we carried out interdisciplinary archaeological work in the valley; Rossen later focused on the Las Pircas phase in the Nanchoc basin during the late 1980s for his doctoral work. Research in the valley was conducted intermittently by Dillehay and others between 1989 and 1997, focusing on both Preceramic and Formative sites.

In the late 1990s to 2008, Dillehay and Alan Kolata carried out an interdisciplinary project in the Jequetepeque Valley, centered on long-term

human and environmental interactions (Dillehay and Kolata 2001, 2003, 2004, 2006, 2008). This research was also concerned with survey and excavation to establish a more precise chronology for the entire pre-Hispanic and Hispanic sequence in the lower and middle valley and to understand more fully the environmental and ecological parameters within which humans altered the landscape and responded to major physical stresses such as El Niño flooding, earthquakes, drought, and tsunamis. The doctoral research projects of Kary Stackelbeck (2008) and Greg Maggard (2010) on Preceramic sites in the Jequetepeque and Chamán valleys were carried out under the auspices of this project. The Preceramic sites studied by both the Zaña-Niepos-Udima and the Jequetepeque projects are included in this book.

Since all research in the Zaña Valley was exploratory in nature and was conducted without benefit of an established Preceramic cultural chronology, we decided to concentrate much of our effort in establishing a local cultural chronology that could be refined through survey and excavation of sites. Although the cultural chronology of the Jequetepeque Valley was better known, we made a similar but less concentrated effort to refine the chronology there as well.

Both projects involved extensive and systematic survey and extensive subsurface testing at various sites throughout the two valleys. While 100 percent coverage was carried out in the lower and middle Jequetepeque Valley, only 70 percent of the Zaña Valley was prospected and most of this was in the middle and upper middle valley. Four-hundred eighty Preceramic sites were recorded in the Jequetepeque Valley and neighboring environs (Dillehay et al. 2009). One hundred eleven Preceramic sites were registered in the Zaña and Nanchoc valleys, providing a total of 591 sites for the entire study area. Although limited paleoecological research was performed in the Zaña Valley, the Jequetepeque project involved extensive paleoecological work (e.g., Dillehay et al. 2009; Maggard 2010; Stackelbeck 2008; Weng et al. 2006). Survey and excavation methodologies are explained in several other documents (e.g., Dillehay et al. 1989, 2009; Maggard 2010; Netherly and Dillehay 1985; Rossen 1991; Stackelbeck 2008) and thus only briefly described below.

PROJECT METHODS

Reconstruction of Preceramic economic and settlement strategies and localized adaptations in the study area came from analyses of archaeological and ecofactual materials collected during the survey and subsurface testing

in both valleys. An intensive pedestrian survey designed to locate, describe, and map all sites was carried out, including most small, side quebradas (alluvial fans) and canyons in the Andean foothills. Each side quebrada is comprised of long, narrow alluvial fan drainages that are bounded by steep to moderately sloping mountain and hill slopes. Survey in these areas usually covered all habitable locations, excluding only the steep slopes.

Topographically, the Preceramic sites are situated on a variety of landforms including ancient paleodunes, coastlines, coastal desert plains, low slopes, and the valley floor of the quebradas or alluvial fans. However, these sites are most densely located on the long, low alluvial cones of the quebradas. Typically, the size of Preceramic sites recorded in the study area ranged between 2,500 and 5,000 m^2, although a few very large sites are present as well (>100,000 m^2). The density of surface artifact scatters varied from sparse (>5 artifacts per 5m^2) to very dense (>100 artifacts per 5m^2). Larger sites typically contained higher densities of surface artifacts, which usually represent multiple occupations and/or longer-term occupation of the same location. Conversely, smaller sites often contained low densities of surface materials and were indicative of short-term campsites, special purpose sites, or single-component but long-term occupational sites. There are exceptions to this pattern, such as the large sites in the Q. del Batán and Q. Talambo areas with high surface artifact densities due to soil deflation. Surface artifacts predominantly consisted of lithic materials, including manufacturing debitage and tools. A wide range of Preceramic projectile points (including Fishtail, Paiján, and other unidentified types) and unifacial tools were collected during survey, along with flakes and other lithic debris, including the different raw material types present. In addition to the lithic materials, numerous features such as domestic structures (circular and rectangular), hearths, lithic workshops, and unidentified rock concentrations were also recorded on the surface of sites, especially in the Nanchoc Valley. Faunal materials were recovered from the surface of many sites and a disturbed human burial was found eroding out of the surface of one site (JE-1002) that also contained early Preceramic materials (Paiján). Human skeletal remains were excavated at several sites in the Nanchoc drainage, including CA-09–27, CA-09–28, CA-09–52, CA-09–71, and CA-09–77 (see Chapter 8).

In addition to documenting the location of sites, the specific distributions of all lithic tools, workshops, and structures were recorded and mapped for many sites, when they were visible. This was usually on the coastal plains and in the lower quebradas of the foothills (i.e., Q. del Batán and Q. Talambo) where there was more archaeological visibility.

Surface mapping was particularly important on sites that contained large quantities of lithic tools and surface features, where distinct, intra-site spatial clusters of tools and activity areas can be observed. Other larger clusters, containing multiple tool forms and debitage, represented overlapping activity areas, or they indicated multiple occupations and use of the same location over time. Ordering these spatial clusters of lithic tools temporally and correlating them with the associated data from features, flotation analysis, and faunal identifications was instrumental in clarifying site function within the larger settlement system, as well as for understanding changes in mobility and increased localization and sedentism within areas of the tightly compressed environmental microzones of the study area (see Chapter 3).

Test and block excavations were conducted at a total of thirty-seven sites between 1981 and 2005 that evidenced a high likelihood of containing intact, subsurface deposits. A general trend of increasing temperatures and, in many areas, aridity has occurred in western South America since the end of the Pleistocene (see Chapter 3). As a result of this increase, archaeological sites are often deflated or compacted (by aeolian and fluvial processes), particularly those closer to the coastal desert plains and located in areas with little vegetation. This situation often reduces archaeological sites to surface scatters with no intact subsurface stratigraphy, although much less so in the forested middle and upper valleys. Within the lower sectors of the study area many sites have been protected by natural landforms from detrimental wind erosion and evidence intact cultural deposits. Subsurface deposits were usually shallow, having been compacted by desiccation and deflation of the overlying sediments, but were identified at more than thirty of sixty-two tested sites. Once again, an exception was some sites in the Nanchoc area that often extended to a depth of 90 centimeters below surface (cmbs). The average depth of subsurface deposits was 20 to 40 cmbs in the lower arid zones and 30 to 90 cmbs in the higher forested areas.

The purpose of the test excavations was to (1) determine if intact subsurface deposits were present within sites; (2) provide stratigraphic and chronological data; (3) collect flotation samples and plant and animal remains for reconstruction of past ecology, resource zone exploitation, seasonality of occupation, and subsistence strategies; and (4) collect artifacts and carbon samples from in situ stratigraphic positions. In addition to the smaller test pits, larger (5 x 5m and larger) blocks were excavated at several sites that demonstrated good, intact subsurface deposits and patterned artifact concentrations. The purpose of these expanded excavations

was to provide additional intra-site spatial and subsistence data by excavating several of the activity areas identified during survey. Flotation samples (4–5 liters) were collected from each excavated level. Tools, carbon samples, and macrobotanical specimens were individually piece-plotted and collected. Several features were encountered, including hearths, pits, lithic workshops, and domestic structures. Features were recorded and excavated separately; flotation samples were collected from entire feature fills.

As a result of these excavations, new data concerning the chronology, subsistence patterns, technology, duration of occupation, and intra-site spatial and activity patterns were derived for a wide variety of Preceramic site types. In general, the block excavations revealed a palimpsest pattern of relatively small, yet dense campsites and activity areas that appear to indicate multiple occupations of the same locations by small groups or permanently occupied locales. An exception was the Nanchoc area where sites were continuously occupied and usually associated with domestic architecture. The sites excavated represent different landforms, physical settings and access to resource zones, and time periods. Numerous radiocarbon samples were collected from various contexts to chronologically order the deposits within and between these sites, as well as to better refine the overall chronology of the Preceramic period (see Appendix 1). These types of associations, combined with the analysis of faunal materials, more than 600 flotation samples collectively taken from sites excavated during all projects, and spatial data from features afford an opportunity to examine the changes in mobility, increased localization and sedentism, and food production from the standpoint of site function and temporality. The results of this analysis were then used to examine larger scale regionalized adaptations based in part on comparisons with nearby studied areas such as Amotape and Cupisnique/Santa Maria (Briceño 1999, 1997; Chauchat 1998, 1988; Dillehay et al. 1989; Richardson 1978, 1973; Rossen 1991, 1998) and southwest Ecuador (Stothert 1985).

The analysis of recovered macro- and micro-botanical materials from intact subsurface deposits specifically allowed for new insights into resource procurement, use of specific micro-environmental zones, and food production. Faunal analysis from sites in nearby areas (Q. Cupisnique and Q. Santa Maria to the immediate south) has indicated that a wide variety of mammals, fish, and reptiles were targeted by early Preceramic groups (Briceño 1997; Chauchat 1988; see Chapters 3, 9, and 10). It is clear that throughout the Preceramic period the trend of reduced mobility to sedentism coincided with an increased emphasis on the reliance and manipulation of plant resources (Dillehay et al. 2007, 2008; Lavallée 2000; Rossen 1991).

In addition to the macro- and micro-plant remains from float samples, pollen, starch grain, and phytolith samples also were taken from all excavation units, at times without much success due to the lack of preservation in some areas or due to turbation and destruction of silica particles comprising phytoliths and other materials (see Chapter 9). However, some success was attained by examining desiccated macro-remains preserved underneath the stones that had fallen from the side walls of domestic structures and by the starch grains preserved on human teeth of skeletons excavated at Las Pircas and Tierra Blanca sites (Dillehay et al. 2008; Piperno and Dillehay 2008).

In addition to site location and internal features, lithics comprised the most detailed and the largest database. A typological and functional analysis of excavated and surface collected lithic materials from each site was performed. Manufacturing debitage was classified according to stages of manufacture based on flake characteristics such as size, weight, flake length and width (measured from and perpendicular to the striking platform), platform angle and thickness, and presence of cortex on dorsal surface in order to provide both production/trajectory models of lithic technological organization and metric data for characterizing inter- and intra-assemblage variability (cf., Andrefsky 1994a, 1994b, 1998; Bamforth 1986, 1991; Collins 1975; Morrow 1997; see Maggard 2010; Rossen 1991; Stackelbeck 2008). Detailed analysis of the lithic materials revealed distinct technological strategies between the Fishtail, Paiján, and later unifacial assemblages and show an increased emphasis on expediency in lithic production over time (Maggard 2010). Low-power microscopic examination of individual tool edges for use-wear polishes, striations, and other indicators were performed on a small sample of lithic tools from all phases to assess tool function (Odell 1989a,b, 1981; Odell and Odell-Vereecken 1980) and were instrumental in identifying the functional roles of specific activity areas (Dillehay and Rossen 2001; Maggard 2010). Raw material identifications also were performed to discriminate procurement areas and identify nonlocal (exotic) raw materials (Church 1994). The kind and availability of raw materials used by different Preceramic groups within the entire study area, which included *toba volcaníca*, quartzite, basalt, rhyolite, dacite, andesite, quartz crystal, and silex (several varieties), were central to reconstructing group mobility and were compared with patterns of raw material procurement made in nearby areas (e.g., Becerra and Gálvez 1996; Rossen 1991, 1998). The geologic variability of the lower and middle Jequetepeque and Zaña valleys makes this a particularly important area when looking at group selectivity among possible raw material resources. Analysis of raw material

used also suggests gradual intensification in the procurement of locally available materials, to a near total exclusion of nonlocal stone during the later phases when people became more sedentary, which likely relates to the larger process of localization.

Data from separately excavated sites in the study area were usefully linked together in terms of an overall system of organization when they were shown to be diagnostic and contemporaneous and when cultural affiliation (e.g., Fishtail, Paiján, or unifacial) could be demonstrated. These criteria were often difficult to directly establish when dealing with Preceramic sites. However, by estimating the nature and length of site occupation, based on the depth and intensity of deposits, along with geographic proximity within individual quebradas, we generated organizational linkages between individual sites by establishing the seasonal and functional roles that specific locations may have played (Binford 1979, 1980; Kelly 1992, 1995; Kent 1991). Seasonality and site function also were addressed with several lines of evidence, including the floral and faunal materials recovered from excavation and flotation and through the presence or absence of activity areas and specific features, such as structures, hearths, pits, and burials. These indicators were compared with independent data generated from the functional analysis of features, artifacts, and intra-site patterning from individual sites to create a more robust picture of the activities that were likely pursued at specific sites.

Last, over the thirty-year period of this project, numerous interdisciplinary, specialty, and statistical studies were conducted by a wide variety of nonarchaeology scientists in Peru, the United States, and Europe. The list of contributors is far too extensive to include here. Readers are advised to consult individual published studies and doctoral dissertations for these individuals and institutions.

DEFINITION OF SITE TYPES

Patterned differences between archaeological sites are assumed to represent distinct types of past human activities within a functioning system (Binford 1983; Gargett and Hayden 1991; Kent 1991; O'Connell 1987). These differences are reflections of the activities that were pursued at specific geographic and ecological locations, which have left behind a correlate material pattern. By approximating the activities that were pursued at specific sites from their individual material records, we combined these activities with the location, size, and frequency of cultural materials to effectively compare the different functions of individual sites within a

given area and within each cultural phase. Comparisons of this sort became more robust if the sites were roughly contemporaneous, and allowed for the identification of groups of site types that likely functioned together as a cultural system and social network. Accelerator mass spectrometry (AMS) and conventional radiocarbon dates from selected excavated sites helped to refine the contemporaneity and chronology of sites (Appendix I), which provided the opportunity to examine how regional settlement and individual site functions changed throughout the Preceramic period.

Site Definitions

Site types form the basis for characterizing the range of variability present in the Preceramic sites recorded during survey and excavation in the study area (see Stackelbeck 2008). Not all site types are represented within all surveyed areas, however. Typological classification of the sites are based on five criteria: (1) site location; (2) site size; (3) type and density of cultural materials; (4) amounts and types of activities represented at a site; and (5) the presence or absence of domestic structures and other features (e.g., canals, furrows) at a site. These criteria are drawn from a summary of the variability that has been reported from previous surveys for Preceramic sites on the north coast of Peru and from the results of prior surveys of the Zaña and Jequetepeque valleys conducted by several researchers (e.g., Becerra 1999; Becerra and Esquerre 1992; Briceño 1995, 1997, 1999; Chauchat 1988, 1998; Dillehay and Kolata 2001; Dillehay et al. 2009; Gálvez 1992, 1999; Malpass 1983; Ossa 1978; Ossa and Moseley 1972; Richardson 1973, 1978, 1983).

Thirteen types were defined in the study area: (1) long-term base camps; (2) short-term base camps; (3) long-term field camps; (4) short-term field camps; (5) processing stations; (6) transitory station/workshops; (7) lithic quarries; (8) mounds; (9) semi-permanent to permanent horticultural residences with gardens; (10) permanent residences associated with irrigation agriculture; (11) agricultural features; (12) hillside villages; and (13) special activity locales. These site types are drawn from and based on those discussed by Binford (1980: 5–12) and Dillehay (1997: 790–791, 2000: 77–83), and are derived from a combination of archaeological and ethnographic data. Each type is defined and discussed below.

LONG-TERM BASE CAMPS

Long-term base camps are locations of extended (multi-seasonal, year-round) hunter-gatherer occupations or habitations. Dillehay (2000: 81)

has noted that these sites are often situated on landforms that offer commanding views of the surrounding landscape and provide ready access to water, fuel, and stone resources. Base camps functioned as the organizational center of all subsistence-related activities for the group (Binford 1980: 9). As such, they contain the widest variety of individual food resource types, including various terrestrial fauna, plant and seed remains (that may indicate multi-seasonality), invertebrates (e.g., landsnails), and marine resources. Because these sites were occupied for extended periods of time and contain a wide variety of subsistence activities, artifact densities (especially lithics) are generally higher and more varied here than in other types of hunter-gatherer sites (Dillehay 1997a,b). Cultural deposits are usually thicker and more extensive at these sites, which usually exhibit domestic structures and large refurbished hearths.

SHORT-TERM BASE CAMPS

Short-term base camps represent seasonal locations of hunter-gatherer occupation. A short-term site stands in contrast to the multi-seasonal long-term base camps in that the occupations are shorter, and the sites are generally smaller and have thinner and/or intermittent cultural deposits (Binford 1980: 8–10; Dillehay 2000: 81). These sites also function as the organizational centers for all subsistence-related activities of a group, but for a more limited period of time.

Short-term base camps contain a wide variety of subsistence-related activities but typically do not contain the high densities of tools and debitage found in long-term base camps. The frequency of specific tool forms is lower due to the more limited duration of occupation.

Spatial segregation of distinct activities should be present at short-term base camps. However, there is much less overlap of individual features and activity areas and no extensive reuse of hearths and/or other activity areas (Dillehay 1997a: 790). Domestic midden accumulations may be present but are limited, thin, and spatially restricted. Domestic structures may also be present and should reflect the seasonal nature of the occupation. Short-term camps are the most abundant of all Preceramic sites in the study area.

LONG-TERM FIELD CAMPS AND SHORT-TERM FIELD CAMPS

Field camps are locations where individual task groups reside while exploiting specific resources. These camps may be occupied for short or long durations. The field camp becomes the "temporary operational center" for the specific task group (Binford 1980: 10). In general, field camps contain

evidence for a relatively limited range of individual activities. The nature of these activities is predominantly based on the specific resource exploited by the task group but may also include food preparation, provisioning, and tool manufacture/maintenance. Given the temporary nature of the occupation at a field camp, the material traces of these activities are not densely deposited, nor are they spatially segregated.

The variety of individual tool categories and debris from tool manufacture are relatively low, and correspond to the extraction/collection of specific resources (Binford 1980: 10–12). Very few to no hearths and pits are present at field camps. The temporary nature of the occupation likely precludes thick midden accumulations and the construction of domestic structures, although small stone-lined windbreaks sometimes appear at these sites.

Short-term and long-term field camps are distinguished from each other by the amount of food preparation and provisioning activities represented. Longer occupations at field camps generate more significant signatures of the daily necessities of the task group members. It is likely that these activities are not as well represented at field camps of shorter occupation.

PROCESSING STATIONS

A processing station is a specialized type of field camp that involves the collection or harvesting of a specific resource that generates large amounts of low value (or waste) material during exploitation. Processing stations represent the intensive, short-term use of a specific location by a task group to acquire and process a specific resource (Dillehay 2000: 81). The intensive collection or harvesting of a resource by the task group may generate accumulations of unused or waste byproducts (e.g., fish harvesting/cleaning, intensive plant collection, mass collection/preparation of landsnails, animal kills/butchering). Processed and collected resources are transported back to the base camp.

In general, few features (hearths/pits) are present unless they are a necessary part of the resource processing (e.g., cooking hearths, roasting pits). When present, hearths or pits constructed for resource processing may be large in size and contain remains of the specific resource being exploited. The range of tool categories is low and reflects the processing activity.

TRANSITORY STATION/WORKSHOPS

Transitory stations/workshop sites are where hunter-gatherers engaged in information gathering, such as observing game or perhaps, other people (Binford 1978; Dillehay 2000a). Typically, these sites are small and

contain evidence of a limited range of activities. Deposited materials are predominantly related to activities accomplished while observing the landscape, like tool manufacture/resharpening (Binford 1979). These sites are used only temporarily, but may be frequently revisited, which can result in accumulations of lithic debris over time and give the appearance of a lithic workshop. Features, if present, are likely limited to small hearths and windbreaks.

LITHIC QUARRIES

Quarries represent locations for the procurement of targeted raw materials for tool manufacture (Dillehay 2000: 82). Typically, these sites are situated at the location of natural outcrops of the targeted raw material. Lithic quarries generally contain large amounts of early stage lithic reduction debris (decortication flakes, primary flakes, cores). Preforms and crude bifaces may also be frequently present at quarries.

EARTHEN MOUNDS

These are sites where small residential mounds or ritual platform mounds are present and associated with specific activities, such as lime production, food preparation, and possibly burial. They are almost always spatially separated from domestic sites, as in the case of CA-09–04, Chical 2, and Macuaco 1 in the middle Zaña Valley (Dillehay et al. 1989).

HORTICULTURAL RESIDENCES WITH GARDENS

These sites are restricted to the upper and middle quebrada sectors of the Nanchoc area and usually associated with the Las Pircas phase. They contain heavy surface and subsurface artifact densities, primarily unifacial ltihics and debitage. Ground stone pallets and bowls and chipped stone sodbusters and occasionally waisted hoes are present. Excavations of these sites reveal well-developed ashy middens, small stone storage structures, elliptical house foundations, and sometimes buried furrowed areas that represent garden plots. They usually reflect year-round occupation. Human remains are often present.

PERMANENT RESIDENCES ASSOCIATED WITH IRRIGATION AGRICULTURE

These sites are usually found near the edge or lower end of large alluvial fans or quebradas where irrigation canals are located and date to the Tierra Blanca phase. They are multi-room rectangular house structures often characterized by deep, thick midden deposits with large and dense quantities of trash, storage facilities, large quantities of commingled burned

and cut human and animal bones associated in prepared floors, unifacial lithic technologies, large well-made grinding stones and hoes, and cultigens. These are clearly intended to be permanent residences of larger households.

AGRICULTURAL FEATURES

Subsurface fragments of narrow ancient canals and shallow furrows in ancient garden plots and agricultural fields were found during survey and excavation in the Zaña Valley and in the Q. Talambo. Although invariably associated with domestic sites, they are classified as a different site type.

HILLSIDE VILLAGES

There is one and possibly two hillside sites that are spatially and architecturally integrated villages with shallow pit houses and nearby public zones. The domestic structures of these sites are usually elliptical and clearly visible on the surface. The houses cluster in groups of six to ten, with the individual clusters interconnected by well-marked footpaths. These sites are located on the summit and upper slopes of low hills. At one site, Cerro Guitarra, is a separate public zone defined by standing boulders forming possible procession lines.

SPECIAL ACTIVITY LOCALES

One site in the Nanchoc area (CA-09–28) contains a well-developed ashy midden with a high artifact density like nearby horticultural residences with gardens, but it does not exhibit other traits of those sites. There are no houses, stone storage units, or furrowed areas. Instead the site contains one complete and several partial human skeletons. This appears to be a special activity mortuary site.

SPATIAL AND TEMPORAL BOUNDARIES OF SITES

The general procedure used to evaluate the spatial boundaries of sites involved drawing lines around the total extent of associated occupational debris on the surface and/or observed in situ in drainage and other cuts. Many sites, especially in the quebradas, occupy topographic rises or alluvial fan remnants that naturally define site boundaries. In other areas, difficulties arose in determining the full areal extent of single component sites with larger multicomponent sites. Some sites were smeared by deflation and downslope washing, thus appearing to be larger than the actual limits of subsurface deposits (Rossen 1991). In those cases, shovel tests allowed

the true site dimensions to be determined. A primary characteristic of all large multicomponent sites was that diagnostic lithics were found in mixed contexts extending over large areas. The chronology and cultural affiliation of the majority of these sites was indeterminate (see Fig. 1.1). We could have forced many of these sites into one phase or another but decided to take a conservative approach and assign phase affiliation primarily on the basis of clear diagnostic stone tools (e.g., Paiján, Fishtail, and other point types; architectural features such as circular and rectangular houses; and so forth). Sites of the Las Pircas and Tierra Blanca phases that contained architectural features were generally smaller in areal extent and more easily defined.

As observed on the GIS/LandSat settlement pattern photos for each phase (see Chapters 4–6, Chapter 12), the distribution of sites in each is nonrandomly clustered in relation to water sources, linear topographic features (e.g., river terraces, dune formations, ocean shorelines), natural environments utilized for subsistence (e.g., alluvial fan, irrigable valley floor, ocean shoreline), and the clustering of sites possibly attracted to other clusters, which is a social phenomenon rather than a natural one. From the photos it also is clear that several larger clusters for the Las Pircas and Tierra Blanca phases are characterized by subareal clusters of sites, especially in the Nanchoc Valley where these two phases are best represented. Finally, although we do not claim to have found all Preceramic sites in the surveyed areas, especially in small, isolated quebradas and in extensive coastal desert areas under modern-day cultivation, the relative distribution patterns through time and space are considered to be accurate of the exploitation and/or occupation of specific habitats and geographic features in all Preceramic phases. But despite any data biases, it is clear that some areas were void or minimally occupied during some phases and that agriculture developed in only certain places.

CHAPTER THREE

Pleistocene and Holocene Environments from the Zaña to the Chicama Valleys 25,000 to 6,000 Years Ago

Patricia J. Netherly

The record of human history in the region from the Zaña Valley to the northern edge of the Chicama Valley from 13,000 to 5000 BP is unique in South American prehistory. It spans eight millennia and is documented by more than 1,200 sites (Dillehay et al. 2009; Chauchat et al. 1998). From valley to valley, the majority of these sites are strikingly arrayed in a north to south pattern on the lower slopes of the western cordillera. During this long period, human groups lived in and utilized the resources of dry forest environments located today between the lower valley floor and 1,200 m. above sea level. Other, apparently more scattered, populations concentrated on the resources of the littoral, the river estuaries, and other coastal wetlands. At the Last Glacial Maximum at the beginning of this long period, the shoreline was ~20 km to the west of its present location because sea level was 100 m lower than at present (Rein et al. 2005; Fig. 3.1). Sea level gradually rose some 100 m (330 feet) to near its present level by the end of this period in the mid-Holocene.

Other than the botanical and faunal clues found in the archaeological deposits themselves – bones, shell, macro-botanical remains, pollen, phytoliths, and starch grains – there is little direct evidence besides the settlement pattern from which the favorableness of the environment can be inferred. In this instance, the archaeological record itself serves as a proxy record for the presence of conditions favorable for human life from the late Pleistocene to the mid-Holocene within a discrete area. The archaeologically recovered macro-botanical and faunal remains provide clues about the resources exploited within a reasonable distance from a residential base; they do not necessarily reflect the immediate surroundings of that base. It is unlikely that people would consistently locate their camps and homesteads in environments lacking key resources over such a long period

of time. The regional continuity of the settlement pattern is a reflection of the relative stability of these environments.

What was the resource base that sustained both foraging and increasingly horticultural populations over such a long period? To begin to answer this question the shifts in temperature, rainfall, and vegetation since the Last Glacial Maximum must first be identified and considered. These changes were not unique; rather, they were part of a cyclical pattern of cold glacial and warmer interglacial periods that had been in place throughout the Pleistocene and before. Since the glacial periods were much longer, the adaptations of plants and animals to these conditions may be considered the norm and the warmer interglacials, including the Holocene, are the exceptions. Thus, the patterning of plant formations today does not necessarily reflect conditions during past glacial periods although biogeographers have found important clues to past conditions in these distributions (Dillon et al. 1995; Piperno and Pearsall 1998; Sarmiento 1975; Simpson 1975).

Finally, we are cognizant of the conditions and impact of human entry into South America during the late Pleistocene after the Last Glacial Maximum. From the information available at present, humans began to enter South America during a period of oscillation between warmer and cooler periods that ended at a colder period, evident in lake cores from Ecuador and northern Peru, corresponding to the Younger Dryas cold period (Clapperton et al. 1997; Dillehay 2000a, 2008; Hansen and Rodbell 1995; Weng et al. 2006). This cold period was followed by a very short and abrupt period of warming: the beginning of the Holocene. After one or two episodes of temperature oscillation, Holocene climate appears to have remained warmer and drier than at present until some 6,000 years ago, when there was a shift toward the cooler and wetter conditions of the present (Bush et al. 2005; Clapperton et al. 1997; Hansen et al. 2003; Weng et al. 2006). There was an important change in the precipitation regime from the Pleistocene to the Holocene that impacted some parts of the study region more than others.

The climate of the study region has been reconstructed by means of analogy with paleoclimate studies in nearby areas in the absence of direct studies nearby. The sharp increase in temperature which signaled the beginning of the Holocene accelerated the rise in sea level from its ~100 m lowstand, which had begun as temperatures began to warm after the glacial maximum (Rein et al. 2005). Two marine cores in the eastern Pacific, although distant from the study region, provide useful information about temperature and climate (Boven and Rea 1998; Heusser and Shackleton 1994;

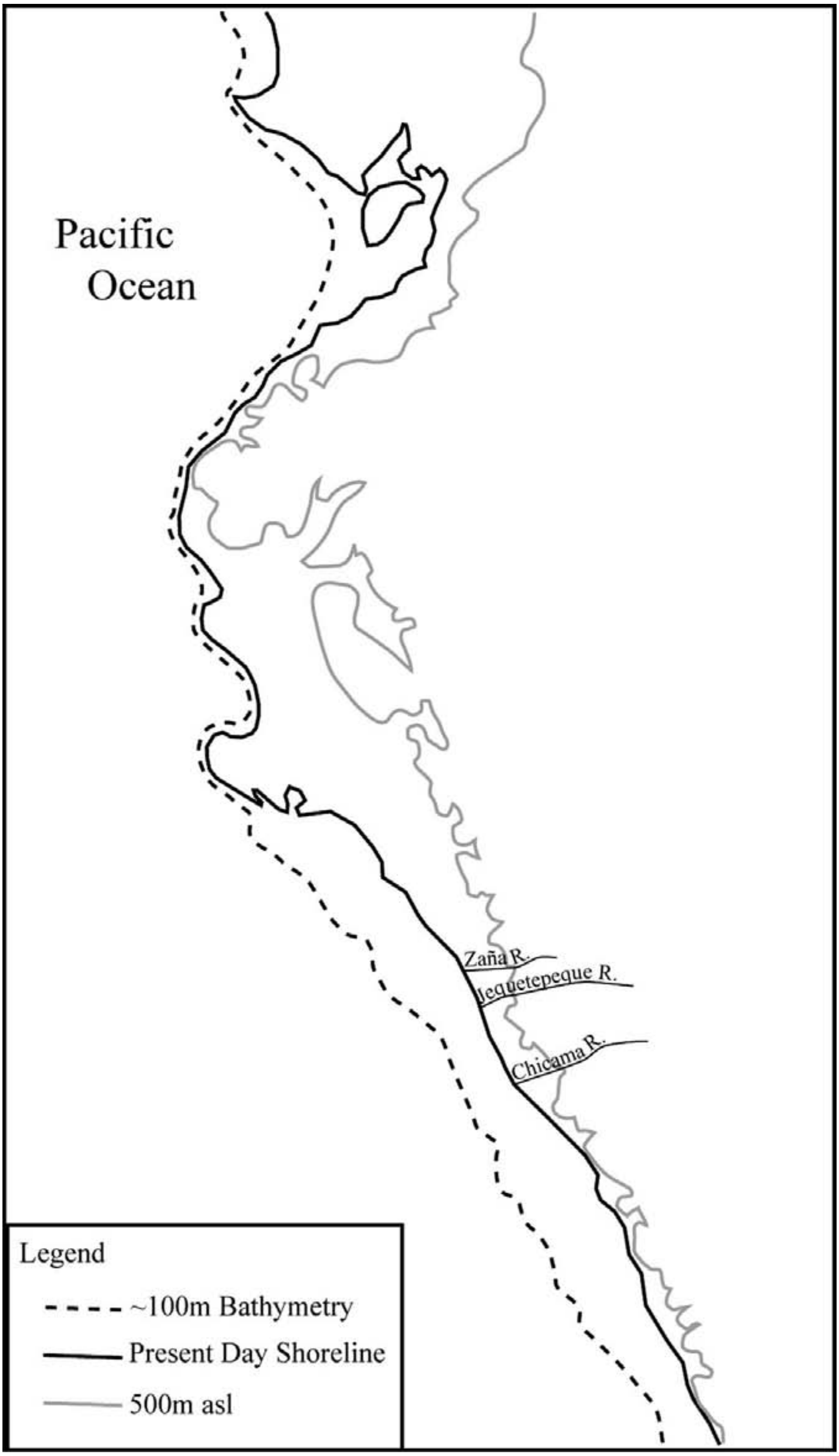


Figure 3.1. Map of the coast with the Pleistocene and modern-day shorelines indicated (redrawn from Ortleib 1989).

Rein et al. 2005). The Pleistocene shoreline lay ~20 km to the west of the present coast as shown in Figure 3.1. Marine transgression across the land to the present coastline began as sea levels began to rise toward the end of the Pleistocene and was not complete until some 6,000 years ago in the mid-Holocene (Ortleib 1989). The rivers of the coastal valleys, which had been at grade with the Pleistocene shorelines, initiated a process of down-cutting to reestablish grade that continues today.

Rainfall patterns differed in the Pleistocene from those of the Holocene. The coast was always arid (DeVries 1987; Ortleib 1989). However, precipitation on the lower western slopes may have been more regular and more abundant. In the highlands, the lowered temperatures of the Pleistocene and regular precipitation caused the growth of both mountain and sheet glaciers in some areas. This depressed the vegetation zones by as much as 1,000 to 1,500 m, greatly altering the highland environment (Colinvaux et al. 2000; Simpson 1975). Vegetation zones on the western slopes of the cordillera (humid montane forest and seasonal or dry forest) may have been compressed but did not disappear (Dillon et al. 1995; Gentry 1995; Sarmiento 1975). However, the associations of plant species may have differed from those of today. The archaeological evidence suggests that the dry forest biomes offered an unusually stable and resource-rich environment for human habitation from the late Pleistocene to the mid-Holocene.

Humans appear to have affected their environment from the very beginning, contributing to the disappearance of some species of Pleistocene megafauna and altering plant communities in the *paramo* through deliberate burning. Human entry is discernible in the pollen record as a spike in carbon particles presumably from burning (Bush et al. 2005; Hansen et al. 2003; Piperno 2007; Piperno and Pearsall 1998; Weng et al. 2006). Also altered by human agency early on were areas of seasonal or dry forest, such as those on the lower western slopes of the Andes, in the region from the Zaña to the Chicama Valleys (Henderson et al. 1991; Janzen 1988). During the Holocene, the impact of humans on the environment increased through burning and clearing. Perhaps at first the intent was to optimize hunting and foraging, and later, on a small scale, to benefit horticulture and subsequently, more extensively, agriculture. This activity, in turn, changed the ranges of many animals but offered opportunities for commensalism to others. Today, dry forest locations are impoverished by over-exploitation, resulting in greater aridity, and contain fewer resources than in the past, which makes it difficult to calculate their original productivity (Henderson et al. 1991; Janzen 1988). In sum, the environments of the littoral, coast, and western slopes of today are not exactly what early human populations

first encountered and even similar environmental zones are not in quite the same places. Whether these zones contain the same or similar associations of plants as they did in the past must be determined.

AN OVERVIEW OF CLIMATE IN NORTHERN SOUTH AMERICA FROM THE LATE GLACIAL MAXIMUM TO THE MID-HOLOCENE

The Pleistocene climate in the study area differed in temperature regime and precipitation patterns from that of today. Both plants and animals living in the area had adapted to these conditions over tens of thousands of years. Many are "out of place" in the Holocene world; some have simply disappeared. Others have adapted successfully or have greater ranges of tolerance. Before taking up the biogeography of the study region in the late Pleistocene and early to mid Holocene, we will consider the basic characteristics of late Pleistocene climate.

The Glacial Climate

Long periods of cold glacial conditions predominated in the Pleistocene, interrupted by much shorter periods of warmer climate of which the Holocene is the most recent and the warmest. It follows that both extant plants and animals must have been adapted to these conditions although not necessarily in the associations or environments where they are found today. Both sea surface temperatures derived from marine sediment cores and paleobotanical studies indicate that ocean and atmospheric temperatures were at least 5 degrees Centigrade lower than today at the Last Glacial Maximum (Colinvaux et al. 2000; Peterson et al. 2000). It has been suggested that the temperature of the eastern Pacific was somewhat warmer than the Atlantic (Rein et al. 2005).

Any attempt to reconstruct the environment and climate of the study area for the period from the late Pleistocene to the mid-Holocene involves bringing in very recent research on the causes of climate. It is now understood that climatic events are caused by interaction between atmospheric and oceanic processes that depend ultimately on astronomical forcing (Cheng et al. 2009; Severinghaus 2009; Wang et al. 2001, 2005, 2008). There are links between the northern and nouthern hemispheres, as part of a single global system (Anderson et al. 2009; Cheng 2009; Koutavas et al. 2002; Severinghaus 2009; Toggweiler 2009; Wang et al. 2001, 2008). During glacial times, northwestern Peru experienced effects similar to the

weakened Asian monsoon in the form of weak, but not absent, El Niño events.

The Intertropical Convergence Zone

One characteristic of the glacial climate was the permanent displacement of the Inter Tropical Convergence Zone (ITCZ) to the southern hemisphere. Today, the ITCZ migrates seasonally between the northern and southern hemispheres and rainfall occurs in discrete seasons (Piperno and Pearsall 1998, Plates 2.1, 2.2). The result was to greatly reduce the rainfall in the northernmost portion of South America and Central America. However, for the area to the south, roughly southernmost Colombia, Ecuador, and northern Peru, the southern displacement of the ITCZ reduced the seasonality of precipitation and brought regular, if moderate, rainfall to the highlands and western slopes of the Andean cordillera. Evidence for the southward movement of the ITCZ during glacial times and its return northward to the Holocene seasonal pattern is new. The move southward of the ITCZ is known from the study of sediment cores from the Cariaco Basin off the northern shore of Venezuela (Haug et al. 2001; Hughen et al. 1996, 2000). Earlier pollen studies from Lake Valencia in Venezuela had documented the arid conditions in that area during the Pleistocene and the return to more humid environments in the Holocene (Bradbury et al. 1981; Leyden 1985).

The impact on the study area was important but probably largely indirect. With the ITCZ in a southern position, possibly centered over Ecuador, rainfall in the northern Peruvian highlands would have been less seasonal. Under glacial conditions, precipitation would not have been excessive but would have been sufficient to build up glacier thickness or charge the water table where there were no glaciers. Even today, the western slopes of the cordillera in the study area receive occasional highland rains. This happens in the Nanchoc basin, a narrow valley with steep sides tucked against a highland massif and in the headwaters of the Zaña Valley; it may also be true for the Quebrada del Batán, which is closer to the sea. On the north side of the Chicama Valley, the Q. Santa Maria, which heads just below the Contumazá salient, may also have received highland rains. Such rainfall did not transform a dry forest into a humid forest, but it did provide runoff for the streams and charged the water table and springs, making the western slopes desirable places to live. The decreased seasonality of the rainfall may have permitted the growth of seasonal forest trees and other

Figure 3.2. Head of the Quebrada del Batán. Note evergreen shrubs fed by subterranean runoff from springs, and deciduous shrubs and grass on higher ground. Today water flows in the streambeds when it rains and for months afterward.

plants tolerant of shorter periods without rain, thus creating associations anomalous in Holocene terms. The geomorphology of the western slopes appears to confirm this. There is abundant evidence for water flow in the streambeds and gullies, but relatively little for sheet flooding or mass wasting on the hill slopes. Dr. Mario Pino, a geologist on the Jequetepeque Project, found evidence for paleosols and humic layers in the basin at the head of the Q. del Batán, indicating wetland conditions there which he tentatively dated to 10000–6000 BP (M. Pino, personal communication to T. Dillehay, 2009; see Fig. 3.2.)

Highland Glaciation

The Pleistocene climate in the northern Peruvian Andes between 5 degrees and 7 degrees South Latitude profoundly affected the distribution of plants and animals. At the Last Glacial Maximum (LGM), mountain glaciers and sheet glaciation on level areas of sufficiently high altitude occupied portions of the Cajamarca highlands east of the Zaña-Chicama region, beginning at c. 3,600 m above sea level – an estimated equilibrium-line altitude (ELA) based on the Potrerillos Glacier near Papallacta, Ecuador; the Sierra de Cajas in Cañar Province, Ecuador; and observations in the western cordillera in the Santa Valley, Peru (Clapperton et al. 1997; Hansen et al.

2003; Rodbell 1993). There may have been variations depending on location; detailed field studies are needed to clarify this point. Geologists with the Pacasmayo/Jequetepeque Project observed the geomorphological evidence for glaciation in the region around Laguna Compuerta (Weng et al. 2006).

Below the immediate periglacial zone was a cold, wet *paramo* zone that supported a herbaceous *paramo* vegetation with some *Polylepis* shrubs or trees. Marine core TR163–31B on the submarine Carnegie Ridge west of Manabí, Ecuador, was analyzed for pollen by Heusser and for eolian and hemipelagic sediment by Boven and Rea. Their results, while not detailed, were consistent with a wet, cool glacial stadial followed by a warm, dry interstadial (Boven and Rea 1998; Heusser and Shackleton 1994). The pollen recovered for the stadial was from *Polylepis* (trees/shrubs) and Poaceae (grasses), both abundant pollen producers (Heusser and Shackleton 1994).

More specific data are now available. Laguna Compuerta, one of the headwater sources for the Río San Miguel – northern tributary of the Pacasmayo River – was cored as part of the Jequetepeque Project. This is the only lake west of the continental divide that has been cored in northern Peru. It lies in a high, level plain that was probably glaciated during the LGM and earlier periods of extensive glaciation. To the west lies a terrain dissected by rivers flowing in steep canyons below mountains that are rarely higher than 3,600 m. For the most part, the topography of this region suggests that there would have been mountaintop glaciers. Apart from the area around Laguna Compuerta at 4200 m, there are few level areas at or above 3,600 m in the highlands east of the study area. To the west in the project area the highlands terminate in salients rising 2,500 to 3,400 m between the river valleys, bringing the highlands much closer to the coastal portion of the valleys than is common farther south.

The results from the Laguna Compuerta cores indicate that from before the Late Glacial Maximum until after the first warming event corresponding to the Bølling-Allerød, there was no accumulation of sediment, a period of presumed glacial advance in the near vicinity of the lake. Within this period there is a hiatus between glacial deposits with low concentrations of pollen corresponding to *paramo* species. A second period of deglaciation was identified by an influx of glacial sediment from retreating glaciers consistent with a warming climate. A return to glacial conditions was signaled by a reduction in pollen and glacial sediment and a low water level in the lake as indicated by a spike in the concentration of *Isoetes* spores. This suggests cooling and is interpreted as the Younger Dryas cold

episode. The early Holocene appears to have been warm and moderately wet. Forest species like *Podocarpus* and *Myrica* reach a peak in abundance and *Isoetes* declines. This process peaks at 8500 BP and by 7300 BP the catchment was free of ice. The mesic species decline, and *Alnus* (alder), which is more drought tolerant, increases. Alder and other trees like *Hedyosmum*, *Myrica*, and *Podocarpus*, may not have been growing at the coring site itself, which is above the tree line. At about the mid-Holocene, the tree species declined and were replaced by grasses and weedy species. This reflects a temperature decline that is observed at sites studied in Peru and Ecuador (Clapperton et al. 1997; Hansen et al. 2003; Weng et al. 2006). This report raises some interesting questions. At an altitude of over 4,000 m., it would be expected that Laguna Compuerta would have been glaciated, which does not appear to have happened. It is possible that if the glaciers were on the western face of the cordillera to the east of the lake, they did not descend to the levels seen in glaciers on the eastern side of the mountains, which receives Amazon moisture (Clapperton et al.1997; Hansen and Rodbell 1995).

It is not possible to judge the descent of the tree line during the glacial advance; this has been variously estimated at 1,000 to 1,500 m for Ecuador by Colinvaux and others (Colinvaux et al. 1997, 2000). The estimated ELA of 3,600 m for the lowest descent of the glaciers suggested above is based on data to the north and south of the study area (Clapperton et al. 1997; Hansen et al. 2003; Rodbell 1993b). La Compuerta at 4,200 m above sea level with the glacial front above that altitude would seem to contradict what is admittedly a hypothesis. Even at 3,600 m, glaciers would have been discontinuous and confined to mountain summits in the highland area to the west above the coast. The few plateaus and the valleys would have been ice free. How much ice there might have been and its thickness would have depended on the amount of precipitation, another variable for which there is no precise information. If the western sierra was largely unglaciated, and therefore warmer, might it have received more rainfall? These are all questions that require field investigation for answers.

What is clear is that temperatures were some 5° to 6° C lower at the LGM. The tree line was probably 1,000 to 1,500 m lower than it is today. Figure 3.3 shows the major vegetation zones at the LGM and should be compared with Figure 3.4 which shows the mid-Holocene distribution. This would have meant that much of the highland region was either barren or a pro-glacial *paramo*. Seasonality was reduced and rain fell more regularly in what can be assumed were moderate to modest amounts, constrained by the glacial conditions. The relatively slow disappearance of the glaciers as documented in the core from Laguna Compuerta would have affected

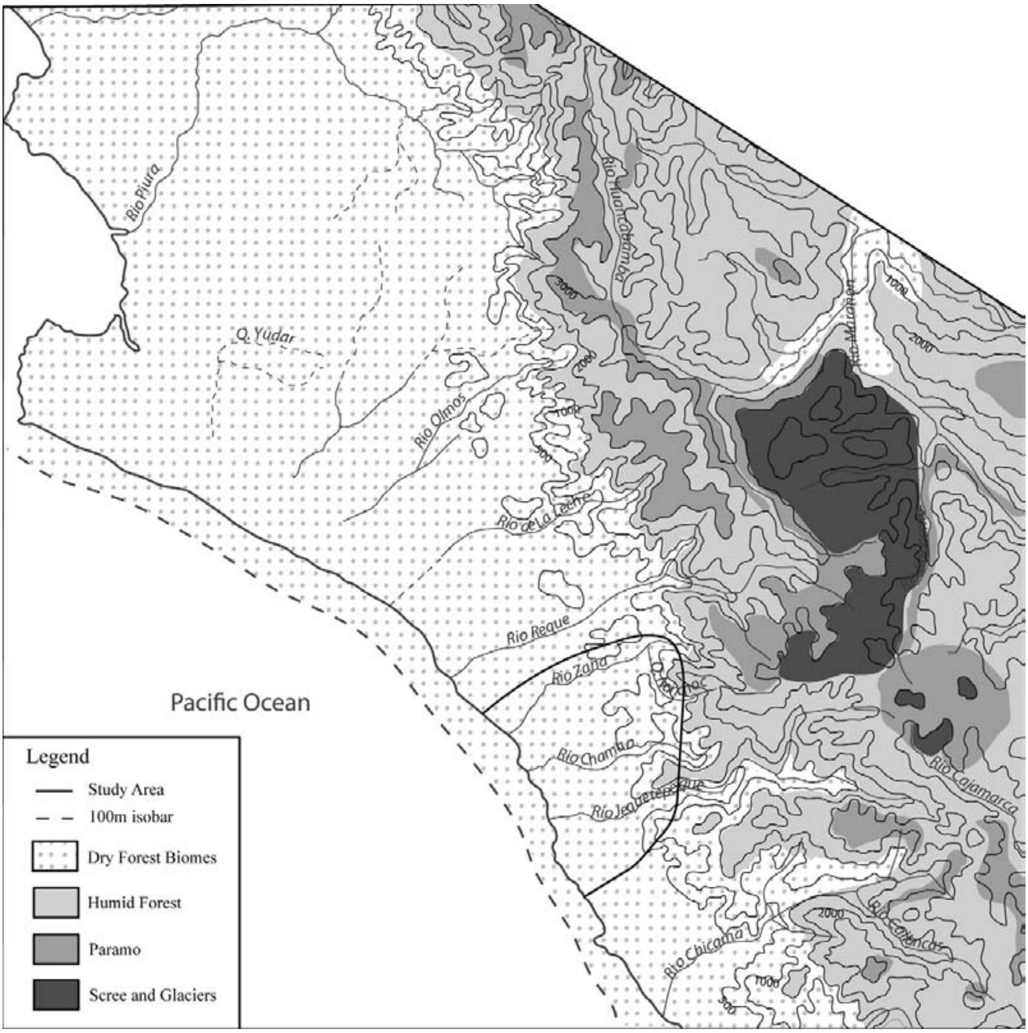


Figure 3.3. Map of the major biogeographic zones at 20,000 BP.

river discharge into valleys like the Jequetepeque, Zaña, and Chicama, prolonging a period of higher discharge than that from rainfall alone. The Chamán and Nanchoc rivers head much closer to the coast and would probably not have been directly influenced by deglaciation discharge. As the Holocene progressed, rainfall became more seasonal and all plant communities underwent changes and reassortment.

The coastal plain had been arid during the Pleistocene and remained so in the Holocene (DeVries 1987; Ortleib 1989; Rein et al. 2005). It is possible that proximity to the sea ameliorated the drop in temperature somewhat. The high water discharge from the highlands to the coast, through the rivers and the water table, diminished through the early Holocene. Perhaps

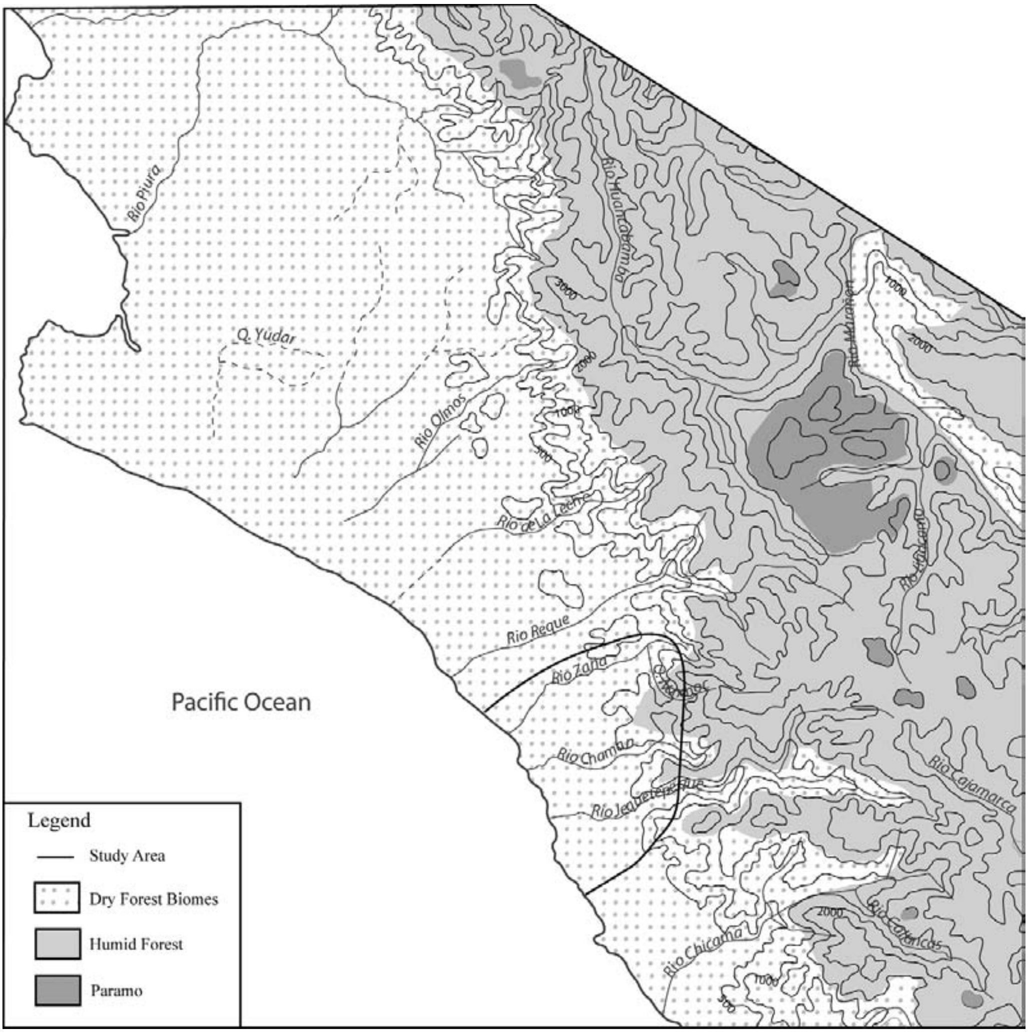


Figure 3.4. Map of mid-Holocene biographic plant formations..

the biggest change experienced on the coast was the increasing strength and frequency of El Niño events (Rein et al. 2005; Wells 1987, 1990).

El Niño-Southern Oscillation

There is a vast literature about the recurring El Niño rains, which in historic and prehistoric times have caused massive flooding on the North Coast, while offering opportunities by causing desert areas to bloom (Ortleib 2000; Quinn 1992). Because the El Niño-Southern Oscillation (ENSO) events were first recognized along the Pacific Coast of South America, there has been a tendency to think of them as local events. This is not the

case, however. These events have been an integral part of the linked global atmospheric/oceanic circulation system throughout the Pleistocene and Holocene. Given the enormous changes in climate over this long span of time (four cold glacial stadials, four warm interstadials), it is no surprise that there were major differences in the ENSO events (Cane 2005; Rein et al. 2005). During cold stadials, the Southern Oscillation moved southward and was thus decoupled from the El Niño, which originates in conditions in the western Pacific. The strength of ENSO events appears to be linked to the temperature of the ocean: cooler temperatures weaken the signal, warmer temperatures strengthen it (Cane 2005; Rein et al. 2005; Rodbell et al. 1999; Wang et al. 2008).

In the analysis of an ocean sediment core on the continental shelf off the coast of Lima, Rein and his co-authors found that the proxy evidence for El Niño events was weak during periods of cold sea surface temperatures (stadials), including the Younger Dryas cold episode, and stronger during interglacial periods when ocean surface temperatures were warmer. The Holocene is an interglacial period. The signals suggest that El Niño events were strongest during the first five millennia of the Early Holocene when the climate was warmer than today. El Niño events were reduced in strength after the climate cooled in the sixth millennium BP but were particularly strong again in the second and third millennia BP, where they have been noted in the archaeological record as well (Rein et al. 2005).

Any attempt to assess the impact of Pleistocene rainfall in the lower valleys and on the lower western slopes of the cordillera in the valleys of the study area must be hypothetical at best. The southward movement of the ITCZ during the cold Pleistocene stadials ensured that there would be precipitation throughout the year in the highlands. The lowered temperature during glacial periods probably ensured that such rainfall was moderate, but sufficient to support the glaciers. This rainfall may have reached the upper western slopes of the cordillera but was probably sporadic at lower elevations. The weak signals for El Niño events during the Pleistocene reported by Rein suggest that the warm waters and their accompanying rainfall did not reach as far south as during the Holocene and that El Niño rainfall was lighter and more sporadic than during the Holocene. Such rains would have fallen on the coastal plain and perhaps the lower western slopes of the cordillera. The weak sedimentary signal in the offshore cores indicates that major flooding events did not occur. Since all evidence indicates that the coast remained arid, as a result of the major reorganization of atmospheric and oceanic circulation patterns during the glacial stadials, the reasonable conclusion is that the vegetation of the coastal plains, away

from areas of high water table, remained adapted to seasonal drought. The presence of intermittent or permanent discharge in streambeds that are dry today would have originated in the more regular rainfall in the highlands. It affected not only the visible streams but also the aquifers that fed springs and seeps on the western slopes and on the coastal plain. This would have supported more mesic plant species in areas of highly seasonal vegetation.

The Holocene pattern became evident after the end of the Younger Dryas cold episode. As temperatures rose and present-day patterns of atmospheric circulation were established, the ITCZ began to move northward on a seasonal basis, following the pattern seen today. This led to more seasonal patterns of rainfall in the highlands and reduced the amount of water discharged into streams and rivers flowing to the coast. Intermittent streams dried up and some permanent streams became intermittent, particularly on the lower western slopes of the cordillera. The underground aquifers were also affected and some springs dried up, others had reduced flow, and in the lower valleys some seeps (*jagueyes* or *puquios*) may have disappeared. The variations in temperature and rainfall experienced during the Holocene have not substantially changed this shift toward greater aridity and the predominance of more drought-tolerant plant associations. The warming global temperatures have fostered the pattern of stronger El Niño events as they have also strengthened the Asian Monsoon (Cane 2005; Rein et al. 2005; Wang et al. 2008).

Glacial Environments: Flora

The Andean region between approximately 4 degrees and 9 degrees South Latitude includes mountain ranges that do not rise above 4,600 m above sea level. They offer a lesser physical barrier than the regions to the north in Loja or to the south in Huamachuco. The relatively low altitude of the mountains and the low pass between Olmos and Jaén means that much of the cordillera was not glaciated and some forest species were able to pass from the eastern slopes of the Andes through the highland forests to the western slopes. Such transfers may have occurred during earlier interglacials. They are reflected in the composition of the humid forest, which contains many species found on the eastern slopes of the Andes (Dillon et al. 1995). However, more important for understanding the distribution of the Pleistocene flora is consideration of the effects of the lowered temperatures and glaciation. It is estimated that the tree line descended some 1,000 to 1,500 m near the equator (Colinvaux et al. 2000).

All major formations – the *paramo*, the humid forest, the humid forest/dry forest transition, and the seasonal forest – were shifted downslope from their Holocene positions (Fig. 3.3). For the study area this could have lowered the tree line to below the edge of the escarpment (at 3,000 m), perhaps to 2,600 or even 2,300 m. Below the glaciers and the immediate periglacial scree, the highlands would have been mantled in *paramo* with humid or dry forest (depending on the patterns of precipitation) in the deep valleys. Because there may have been less rainfall at the western edge of the sierra for the reasons indicated earlier, the humid forest zone may well have been confined to a narrower band than it is today. In the upper Zaña Valley, a belt of transitional vegetation between the dry and humid forests was observed between 1,200 and 1,600 masl on the western slopes of the escarpments on the road between Monteseco and Udima. Weberbauer had already recognized such a zone, consisting of deciduous and evergreen dry forest species growing together with hardier wet forest trees (1936, 1945). In Pleistocene times the constituents of such a zone might well have been different, but the suggestion can be made that such a zone was present. It is difficult to judge the eastern limit of the deciduous dry forest which today is at about 1,200 m in the Zaña Valley and recognize that the constituent members of each formation may have differed from those of today (Colinvaux et al. 1997, 2000). There would have been fewer species from the more arid associations of the dry forest spectrum. Without proxy corroboration, this can only be reasoned speculation.

What would strike a time traveler to the study region at the LGM would be the barrenness of much of the highlands: either glacial ice or scree or cold, wet *paramo*. Trees would be found only in sheltered spots or the upper part of the valleys, first in a humid forest formation. Farther downslope there would be a transition association that had elements of the humid forest and evergreen species from the seasonal forest below. The dry forest biomes would have covered the lower western slopes and the lower valleys, where there would have been a quantity of trees, both extreme aridity tolerant types, such as *zapote* (*Capparis* sp.), and others that never reach their full growth potential today (see Appendix 2, Figure A2.1). Additionally, a whole range of other trees, some more tolerant of seasonal drought than others, were interspersed in more mesic microzones across the lower valley. Water flowed in streams down ravines that are now dry but supported a riverine growth. There may have been a green veil of seasonal growth on the lower slopes. In the middle and lower valleys, springs and lagunas, fed by groundwater, would have been fringed, if not choked, with

reeds. Keeping all this exuberance in check were the browsers and grazers among the megafauna. Nonetheless, the general effect would have been much greener than the natural vegetation of these valleys is today.

Glacial Environments: Fauna

The Pleistocene fauna of northwestern Peru was a mix of species from the southern and northern hemispheres. More important, in the New World as in the Old, there were enormous animals (megafauna) of species from both hemispheres during the glacial and interglacial periods up to the Holocene. Pertinent to this study is the Carolinian megafauna from the Santa Elena Peninsula and the Pacific coast in Ecuador. This late Pleistocene fauna was studied by Hoffsetter (1948, 1952) in the middle of the last century and more recently by Ficcarelli et al. (2003). The Pleistocene terrain on the Santa Elena Peninsula ranged from mesic forests, through dry forests to savanna and wetlands, very like the study region. Investigators have also reported megafaunal remains at the El Cautivo site, which are associated with lithics. These artifacts have not been typed or precisely dated but would appear to be slightly earlier than the initial Las Vegas I culture (Ficcarelli et al. 2003; Stothert 1985, 2003; Wunch and Piqué 1995). If the stratigraphy is correct, this would put humans and terminal Pleistocene megafauna in association on the Santa Elena Peninsula at the Pleistocene/Holocene transition sometime before 10,000 years ago.

The floor of the Gulf of Guayaquil was dry land during the Pleistocene. The Gulf is only 30 m deep at its greatest depth in the west. During the Pleistocene it formed the lower part of the valley of the proto-Guayas River before the rise in sea level from the end of the Pleistocene to the mid-Holocene. There is a massive cone of alluvial sediment deposited off the edge of the continental shelf by the proto-Guayas that can be seen on any map showing detailed bathymetry. This suggests that the late Pleistocene fauna recovered from the La Brea tar deposits at Talara in northern Peru were part of a larger population. This fauna closely resembles the Carolinian fauna (Campbell 1979; Churcher 1959; Lemon and Churcher 1961). Lemon and Churcher suggest that the environment around the Talara deposits was a wooded savanna crossed by watercourses: some of which were permanent streams.

No megafauna have been found in the Zaña-Jequetepeque study area. However, Rafael Larco Hoyle first reported the remains of megafauna just to the south in the Chicama Valley on the Pampa de los Fósiles in an

area of savanna, intermittent or permanent streams, and wetlands (1948). These fauna have not been studied or dated. However, in the valley of the Rio Seco between the Chicama and Moche valleys, Ossa excavated a deposit with broken bones from gomphotheres and equids associated with lithics at the La Cumbre Site. Two carbon dates were obtained. One on bone apatite from bone recovered in situ was 13460 ± 700 BP. The second, also on bone apatite, came from an area of secondary deposition, and was 11305 ± 280 BP. The first sample came from within the same level as an assemblage of early lithics. The environment of this site was reconstructed as a savanna or savanna parkland along a watercourse (the Río Seco), which is now dry (Ossa and Moseley 1971).

It is clear from the dates from La Cumbre, and from El Cautivo in Ecuador that at least some species of Pleistocene megafauna lingered on some 1,000 to 1,500 years after human populations had entered the Zaña and Jequetepeque Valleys. It would seem that the environment through the Pleistocene/Holocene transition supported a megafauna population. The abrupt climatic shift toward increased seasonality and aridity that signals the beginning of the Holocene brought about a shift from well-watered savanna parkland to dry scrub and dry forest. This change, together with hunting pressure from human populations, could explain the rapid disappearance of the megafauna thereafter. The mid-sized fauna that survived the transition – Virginia deer, peccary, spectacled bear, the large rodents – remained in the area and were hunted. These animals can survive in a dry forest environment. Mares has drawn attention to the great diversity of the Holocene mammalian fauna found at present in arid environments throughout South America (1992). Many of the smaller mammals that were present in the dry forest environment at the beginning of the Holocene may have departed or gone locally extinct during the Holocene as a result of the burning and other habitat destruction brought about by the heavy human use of the dry forest from the very beginning. Given the range of habitats afforded by the different dry forest associations, it would be well to look more widely to find homologues for some of the small mammals recovered archaeologically during the Holocene (Rossen 1991; Stackelbeck 2008).

Janzen and Martin (1982) have drawn attention to the adaptive adjustments in Central America between plants and the megafauna that developed over the course of the long Pleistocene epoch. These include protective measures, such as the development of large thorns, but also reproductive adjustments where seeds were ingested with fruit and deposited at a distance in the dung. A number of different trees with three-inch thorns and a similar fruiting pattern are found in the western Amazon

region of Ecuador near the Andes. Similar trees have not been seen within the study area.

BIOGEOGRAPHY OF THE NORTHERN ANDES FROM THE PLEISTOCENE/HOLOCENE TRANSITION TO THE MID-HOLOCENE

This period, lasting some six thousand years, saw transformative changes in temperature, rainfall patterns, and distribution of plant associations. By the end of the period, present-day weather patterns and the principal biogeographic formations shown in Figure 3.4 were in place. This biogeographic study begins with descriptions of the three principal formations present in the northern Andean region: the *paramo*, the humid montane forest, and the seasonal or dry forest. Specialized formations, particularly those of the coastal wetlands and littoral will be noted as well. Since the goal is to account for the environments in which early foragers and horticulturalists lived, more attention will be given to the seasonal forest and the wetland formations than to the others.

Paramo

The *paramo* is a unique plant association found in the high northern Andes. It lies immediately below the barren rocky zone below the snow line. An association of grasses, cushion plants, and other plant species adapted to this zone make the *paramo* distinctive. At its lower edge it grades into the humid montane forest that lies below it. It exists today as a series of high altitude islands whose fauna and flora are isolated. Separation from other populations has brought about speciation. However, studies of the birds and biogeography of the *paramo* carried out some fifty years ago have made it clear that at some point in the past these *paramo* islands had coalesced into larger units, thus creating larger populations of both fauna and flora in response to the lowered snow lines during times of glacial advance (Simpson 1975; B. Vuilleumier 1971).

The term *paramo* is also used for the humid grassland that lies below the nival zone in the northern Andes of Peru. While it lacks the specialized plant forms of the northernmost Andes, this association is also adapted to a cold, wet climate. With the lowering of vegetation lines in the study area, the lower margin of the *paramo* may well have been below the Zaña/Udima escarpment at 3,000 m in the Zaña Valley and below the Niepos escarpment in the Nanchoc basin. In the late Pleistocene as temperatures warmed, the

Figure 3.5. Humid montane forest, looking toward El Cedro from the east.

paramo moved upslope, followed by the humid montane forest and, to a lesser extent by the seasonal forest.

Humid Montane Forest

The humid montane forest formation lies just below the *paramo*. Figure 3.5 shows the humid montane forest at the head of the Zaña Valley as it is today. The forest is found at an altitude of 3,400 m on the highland plateaus as well as the upper slopes of the mountains. This represents a movement upward as temperatures warmed from Pleistocene levels to the modern values. In the Zaña Valley and the Nanchoc basin most of the forest has been cleared from highland areas and down the steep escarpments to an altitude of 2,600 m. Today, throughout the northern Andes only a few thousand hectares remain of what was once a very extensive formation. The forest is maintained by seasonal rainfall and by dense fog and mist that recycles the condensed evapotranspiration from the forest itself and falls at night as a fine rain. In the humid forest the ground is saturated most of the time (Fig. 3.6.)

The humid forest is an ancient formation. Unlike the lowland forests of the Amazon, where there are many species of South American origin, many of the species of the Andean humid montane forests are of North American origin, part of a group of temperate species that entered the

Figure 3.6. Fog filling the Zaña Valley during dry season months, view downvalley from Monteseco.

highlands when the Isthmus of Panama was closed (Dillon et al. 1995; Gentry 1982). Some, like *Quercus* (oak), do not replace Andean species like *Hedyosmum* south of the Colombian border with Ecuador. The humid montane forest of the northern Peruvian Andes does not extend farther south than 8 degrees South Latitude, that is, the Chicama Valley; its links are to the north (Bush 2007). These forests were described in some detail for the Piura region by Weberbauer (1936, 1945). The Koepckes also described the forests at Monteseco and in Piura (Koepcke and Koepcke 1958; W. Koepcke 1961).

A recent biogeographical study by Michael Dillon of five relict montane forests of northern Peru has clarified the relationship of these forests to each other and to more distant areas of montane forest in Ecuador and on the eastern slopes of the Andes. Dillon studied what he calls the Monteseco forest at the head of the Zaña Valley in western Cajamarca, the small Cachil forest on the northern flank of the Chicama Valley between Cascas and Contumazá in La Libertad, the much larger Cutervo forest near San Antonio de Cutervo in Chota, and the Canchaque forest scattered at the head of the Piura River in Piura. Inventory lists from each location were compared with each other and with three locations in Ecuador: Jauneche and Río Palenque, both lowland sites in Guayas Province, as well as Maquipucuna, a reserve in the montane forest of western Pichincha. The inventories were also compared with one from the Río Abiseo Park

on the eastern slopes of the Andes in Peru. The two lowland Ecuadorian sites, Jauneche and Río Palenque, shared the highest percentage of species. They were less similar to the humid montane forest at Maquipucuna in western Pichincha, Ecuador. The Monteseco flora shared fewer species with Jauneche and Río Palenque but shared more with the montane forest at Maquipucuna. The Monteseco flora showed the same degree of similarity to the flora at Maquipucuna and that at Rio Abíseo on the eastern slopes of the Andes. The flora of the Cutervo forest in Chota and the other forests studied show greater similarity to Río Abiseo than to Maquipucuna (Dillon 1994; Dillon et al. 1995).

These results are significant because they corroborate the existence in Pleistocene times of a continuous, or nearly continuous, belt of humid montane forest extending north from northern Peru at least into Ecuador. Holocene warming has permitted these forests to move upslope and consequently to become separated. Also significant is the large number of species from the upper slopes of the eastern cordillera at Río Abiseo. It is probable that the forests of the eastern slopes of the Andes ascended the Marañón Valley during the Pleistocene and that some species were able to cross the low-lying Andes at the Huancabamba Deflection, which has been arid in the Holocene but was probably forested during the wetter Pleistocene.

These results are confirmed by those obtained by Cadle, a herpetologist, who collected at Monteseco in the upper Zaña Valley and reported on the reptilian fauna (Dillon and Cadle 1991). Cadle found five new species of lizards that are most similar to others described for forested areas of northern Peru and southern Ecuador (Cadle 1991). A new snake of the genus *Coniophanes* was also identified. It was found in the montane forest and also in the transition to the mesic zone of the dry forest and in areas of coffee production. The closest related species is reported from southern Ecuador (Cadle 1989). Part of the area where Cadle collected lies just above the cooperative center at Monteseco. This is the upper limit of the seasonal forest where it grades into the transitional forest (Weberbauer 1936). In the past there would have been a connection with the upper montane forest at the head of the Nanchoc basin to the south through forest on the Niepos salient or just to the east. Thus, it is probable that many of these species were present there as well. It is also clear these reptiles are near the southern limit of their range. Their genetic ties are with the fauna of northern Peru and Ecuador. This is another indication that their environment, the humid montane forest, was connected with similar forests to the north and corroborates the floristic links (Dillon et al. 1995; Simpson 1975).

The biogeographic conclusions that can be drawn from these studies suggest that humid montane forest was present in the upper valleys of the coast during glacial times at a lower elevation than the surviving forests of today. There was a band of continuous or almost continuous humid montane forest from 7 degrees South Latitude north into southern Ecuador and beyond during the Pleistocene (Dillon et al. 1995). As the climate warmed and the Holocene progressed, the humid montane forest moved upslope and entered the adjacent highlands without leaving the upper valleys. There it was broken up by geographic and climatic barriers (Dillon et al. 1995; Weberbauer 1936). The five forests studied by Dillon became islands that have been isolated throughout the Holocene. Today, the altitude at which the humid montane forest occurs drops from south to north as temperature rises and rainfall becomes more plentiful (Dillon et al. 1995; Weberbauer 1936).

What use human populations might have made of the humid montane forest is not clear. There are early sites within the upper dry forest zone below Monteseco, but the archaeological survey did not extend into the montane forest. Late Preceramic occupation was located at La Toma on the rim of the escarpment in an area that was probably forested at the mid-Holocene. The species inventories for the humid montane forest do not show plants known to be important for human subsistence or as a source for domesticates, although it is possible that some important plants for ritual or medicinal use were found in these forests (Dillon 2003a,b,c). The archaeological imagination was captivated by the humid montane forest, but the important biozone was the seasonally dry forest found below it in a series of associations that offered far more resources to early hunters, foragers, and horticulturalists.

Seasonal Dry Forests

Seasonal or dry forest is the most important biogeographic formation in the study area. It includes plants adapted to months and even years without rainfall. Plants adapted to recurring aridity frequently have structures for storing carbohydrates for energy. Dry forest is also the least-known biome, in part because so little remains undisturbed. This is true for the study area where there is no unaltered dry forest and our best examples of different associations are found on the far margins of the region. Nonetheless, the importance of dry forest for human habitation cannot be overestimated.

The distribution of dry forest biomes in South America, like the distribution of wet montane forest, was more extensive during the Pleistocene

and early to mid-Holocene than at present (Henderson et al. 1991; Janzen 1988; Janzen and Martin 1982). They extended in a broad belt along the lower western slopes of the Andes below the humid montane forest from Panama to the Chicama Valley and onto the coastal plain of the lower valleys.

Biogeographers now distinguish between wet forests, including tropical and temperate rainforests, and dry forests, which receive rain between two and ten months of the year (Holbrook et al. 1995; Mooney et al. 1995; Murphy and Lugo 1986). Basically, this is a broad distinction between wet or humid evergreen forests and seasonal or dry forests. However, the dry forest category includes a wide range of associations previously defined as desert scrub, thorn scrub, savanna woodland, deciduous forest, and semi-arid evergreen forest. These descriptive categories, well known to archaeologists, characterize the associations present today or in the very recent past but do not describe biogeographic distributions during the Pleistocene or the changes brought about by the transition to Holocene conditions (Acosta Solís 1968, 1970; Tosi 1960, 1964).

Seasonal forests include species that are deciduous during the dry season and even drought-specialized plants such as cacti. Leaf loss is a mechanism by which plants respond to the low levels of soil moisture and the high levels of evaporation that characterize rainless seasons. However, deeply rooted trees may remain evergreen throughout the year and may have much higher ratios of root to stem mass. In lowland dry forests there is a correlation between the height of the canopy and the length of the dry season. Dry forests tend to be lower and more open than wet forests (Holbrook et al. 1995). Most studies of dry forests have been confined to trees, but, as Henderson et al. have demonstrated, these forests are extremely rich in nonarboreal species to the point of rivaling the Amazonian rainforest (1991). They are also the source of many plants later taken into domestication as food such as squash and sweet potato, or for technological use, such as gourds and cotton (Piperno 2007; Piperno and Pearsall 1998). All of these characteristics can be found to a greater or lesser degree in the dry forests of the lower Andean slopes and lower valleys of northwestern South America.

Like the species found in the humid montane forest, many dry forest species are similar to northern species. In an early biogeographic study, Sarmiento characterized the dry regions of South America and their vegetation (1975). He found that the associations from Ecuador and northern Peru were very closely related to those of the Caribbean coast and the dry north Andean mountain valleys. Since there are affinities

between these associations and those of Central America and Mexico, although Sarmiento did not venture this far, it is reasonable to suppose that these three associations represent the influx of northern species after closure of the Isthmus at the end of the Pliocene. In a taxonomic study departing from somewhat different considerations, Gentry notes the predominance of autochthonous taxa in lowland moist forests to the east (1982). He finds taxa deriving from North and Central America concentrated in the northern Andes and in the northern arid regions. In his description, Gentry separates the Caribbean coast as one phytogeographic region from the North Andes, which combines the northern Andean valleys and coastal Ecuador and northern Peru. Although this study has greater time depth, it does not contradict the conclusions noted above by Sarmiento.

The apparent barrier to the expansion of dry forest species from the Pacific coast of Panama into the Pacific coastal regions of northwest South America was the extremely wet forest found on Pacific slopes of the Colombian Andes. This anomaly can be understood, at least hypothetically, by keeping in mind the position of the ITCZ during the Pleistocene. Since it was displaced to the south, it is possible that the extremely high rainfall today in the Chocó on the Pacific coast of Colombia is a phenomenon of the Holocene. Under Pleistocene conditions of aridity in northern South America, the Chocó may have been more arid and supported dry forest. The cores taken in this region are all Holocene in date and indicate the high rainfall regimen has been in place for 7,000 years which tends to reinforce this hypothesis (Behling et al. 1998; Berrío et al. 2000). Piperno has also raised the question of the similarities of the dry forests of Pacific coast of Panama with those of western South America (2007).

Thus, the dry forest biome of northwestern Peru has connections with similar formations in Ecuador and Colombia and along the Caribbean coast and beyond into Central America (Gentry 1982; Sarmiento 1975). Because they are found at lower altitudes, there have been more connections between these distant dry forest formations during the Holocene than was the case for the humid forest and *paramo*. Some seasonal forest species form part of the ancient ring of seasonal forest that appears to have surrounded the rainforest of the Amazon Basin during the Pleistocene (Pennington et al. 2000; Prado and Gibbs 1993). These longitudinal connections complement the transverse, upvalley patterns with which archaeologists of the North Coast are familiar. What the familiar transect between the coast and the lower mountain slopes does offer is a view of the different associations making up the seasonal forest.

Figure 3.7. Transition vegetation of dry or seasonal to humid montane forest between Monteseco and Udima at c. 1,400 m. above sea level. All large trees removed for commercial timber.

There do not appear to be altitudinal constraints on the dry forest association below 1,000 m. The environmental constraint is moisture. Moreover, there are no data for the interface of dry forest associations on the valley floor with less drought-tolerant seasonal forest formations found on the lower western slopes of the cordillera. At best it can only be said that major types of vegetation, such as trees, are missing but that in some cases there would appear to have been a transition from a lowland species to others within the same genus adapted to the warmer and dryer climate of the western slopes. This appears to be the case with *Capparis* sp. (Gushiken et al. 2001; Rodriguez et al. 1993; Weberbauer 1936). The impact of rainfall events, either highland rains or ENSO events, is also difficult to assess except by analogy with modern conditions. At the end of the Pleistocene from northern Peru to Ecuador and into Colombia, the seasonal forest biome was the most extensive biogeographic formation, covering the valleys and the western slopes of the cordillera up to the contact zone with humid montane forest (Fig. 3.7.) Human intervention has left very little of the seasonal forest intact, making it difficult to assess its "pristine" potential for hunter-foragers and incipient horticulturalists (Henderson et al.1991; Janzen 1988; Piperno and Pearsall 1998; see Figs. 3.8, 3.9).

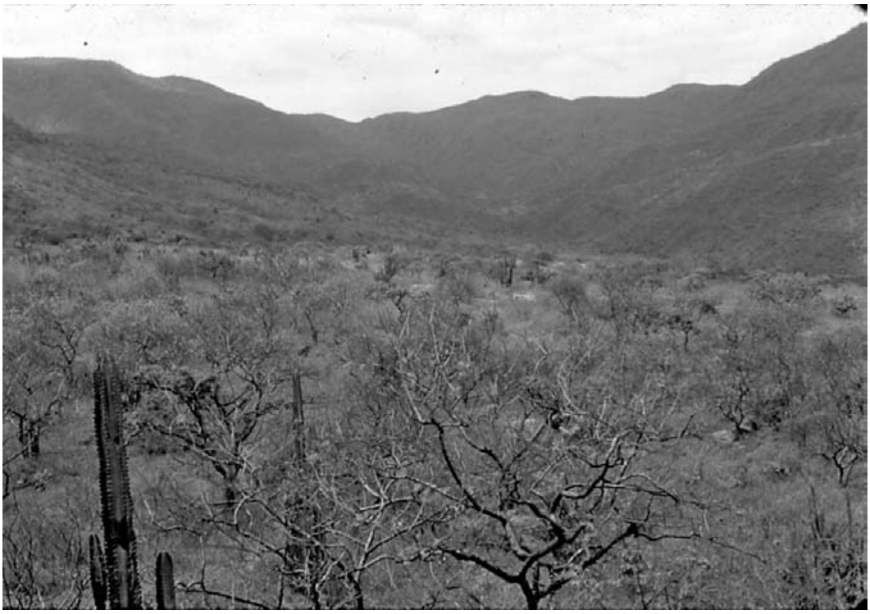


Figure 3.8. Quebrada del Batán. Deciduous shrubs and seasonal grass and cactus in the lower part of the quebrada.

Figure 3.9. Deciduous and evergreen shrubs with seasonal grass in upper Quebrada Talambo.

A detailed description of the dry forest biomes, the plant associations that characterize them, together with a consideration of specific adaptations to extreme seasonality is provided in Appendix 2, where data productivity on forest from Piura where more dry forest survives, is presented in detail.

In order to understand the desirability of the dry forest, or better, the suite of dry forest biomes for early inhabitants of the region, a new perspective is needed. In the first place, dry forest plants adapt to extreme seasonality. It has been said that the climatic regime of the coastal regions of northwestern Peru is unstable, with prolonged periods of drought and relatively short and intermittent episodes of abundant moisture (Gushiken 2001). However, this is looking at the regional climate and environment from the wrong end. Dry forests are ancient in northwestern South America. Early human populations had to adapt to these conditions very early. If the more arid conditions in dry forests are the norm with plant resources such as tubers, berries, and seeds and small game available even in times of drought, together with the permanent resources found in springs, wetlands, estuaries, and along the rivers, then the sudden abundance brought about by intermittent seasonal rains or those occasioned by ENSO events represent the "instability" in the environment. Clearly these wet periods are necessary for plant growth (see Appendix 2). They also bring opportunities to hunt lizards, birds, and small to large mammals or gather seasonal invertebrates such as snails during periods of unusual abundance. However, even without the punctuated abundance brought by ENSO events, the dry forest is a well-stocked larder. This would have been even more the case during the late Pleistocene when human groups were actually moving into the study area. Depending on the mosaic of wetland environments available to particular foraging populations, these resources, complemented by a more mesic environment, may be available without too much extra effort. During the more arid conditions of the early to mid-Holocene, human groups may have found that it was simpler to move seasonally to an area of permanent resources, such as the coastal wetlands or river estuaries, where fish, crayfish, birds, reeds, and reed bulbs would have been available during times of seasonal or unusually prolonged aridity or make a shift in primary subsistence toward irrigated horticulture.

Wetlands: Back Swamps, Estuaries, and Freshwater Ponds

Wetlands are found in three geomorphological contexts on the coastal plains of the valleys of the study region: the back swamps, long depressions

Figure 3.10. View of wetlands inland from the littoral in the northern Chicama Valley.

behind the beach ridges characterized by a high water table with salt or brackish water; the low-lying areas around the estuaries of the rivers, which may include abandoned river channels and lagoons; and depressions farther inland that approach the water table. These ponds or *lagunas* can support a hydrophytic vegetation away from the river and inland from the littoral and may be surrounded by much more xeric associations. In this, their importance is similar to that of the permanent springs found on the lower western slopes of the cordillera (Fig. 3.10). Brackish water and freshwater wetlands support somewhat different vegetation but for the most part of the same general type. Detailed information as to species is found in Appendix 2. Sizable fish are found in the back swamps and estuaries where they are refreshed by the sea. Freshwater fish and crayfish are found in the river and enter floodplain ponds when the river floods its banks.

Wetlands are also important feeding and resting places for waterfowl: ducks, herons, flamingos, and others (M. Koepcke 1954:42–44, 1961). Adding the availability of avifauna, some species autochthonous and other migratory, to the plant and fish resources, the unique productivity of this ecozone becomes apparent. Both plant and faunal food resources would have been available year round. Large trees would have grown along the river bank and around ponds or where the water table was sufficiently high

to support them (Fig. 3.11). The very early sites at Carrizal in the lower Zaña Valley on an abandoned channel of the Zaña River were riverine in orientation, since at that time the littoral would have been farther west and the river consequently less brackish. In addition to reeds and other water plants, fish and crustaceans and wildfowl would have been available year round.

ENVIRONMENTAL RECORDS IN THE STUDY REGION

In general, the botanical and faunal evidence from the archaeological excavations parallels the inferences we have made regarding the late Pleistocene and early to middle Holocene climate. The late Pleistocene climate featured regular precipitation and may have been cooler. There were more active springs and streams. The vegetation may have included species at the more mesic end of the dry forest spectrum. Nonetheless, the areas occupied by humans during this time period lay within the seasonal forest zone. One example of this early climate was reported by geomorphologist Mario Pino, who worked with the Pacasmayo-Jequetepeque Project. In the basin at the head of the Q. del Batán where streams from several springs come together even today (Figure 3.8), a buried organic paleosol that extended some 300 m and was 30 cm thick was observed. This is interpreted to be the result of an area of ponding and vegetation dating to the late Pleistocene (M. Pino, personal communication, 2009). This area was densely occupied by the earliest populations entering the region. After the abrupt end of the Pleistocene at the end of the Younger Dryas and the reestablishment of the seasonal movement north of the ITCZ, the rainfall patterns would have changed. The Q. del Batán would have been affected by the increased seasonality of highland rains. The more drought-tolerant dry forest species became more prominent and it appears that human occupation of this quebrada became seasonal.

For the study areas in the Jequetepeque Valley, the increased strength of the ENSO events would have compensated for this change, but only up to a point. Heavy cyclical rainfall would recharge the aquifers, springs, and watercourses for a while. There would have been a burst of growth of herbaceous plants and growth spurts in many trees (Fig. 3.9; Appendix 2, Table A2.3, Fig. A2.1). A recognized sequence of events follows: Insects, particularly locusts, swarm; snails emerge from dormancy to feed on the vegetation; lizards also emerge, some, like *Scutalus,* to browse the vegetation, others to capture insects. Small mammals proliferate and foxes abound. Larger carnivores, like the felids, enter the region. Probably larger

Figure 3.11. View of the estuary of the Zaña River; Pacific Ocean is beyond the barrier beach. A small Preceramic site is in foreground.

mammals like deer and peccary, attracted by the abundant food resources, also enter zones where they might not otherwise be found. As the vegetation begins to die back, the snails, lizards, and snakes return to estivation and small mammals die off. The larger creatures may have returned to other, more mesic areas; some may have starved. For foraging humans, during and after an ENSO event or under a regime of more frequent rainfall, seasonal dry forest becomes a larder from which both plant and animal subsistence can be obtained over an extended period of time, which may last several months or even as long as one or two years. For the long periods between strong ENSO events, human populations relied on other strategies.

The other "larder" environments available to these populations are the wetlands and estuaries. These offered permanent resources: fish, waterfowl, and plant resources such as the bulbs of reeds and *achira*. Some populations remained in the wetland environment on a permanent basis. It would appear that the later inhabitants of Q. Talambo and Q. del Batán either visited the wetlands or traded for salted or dried fish (Netherly 1986; Stackelbeck 2008).

The Nanchoc basin appears to have had permanent local resources. There are no wetlands beyond small springs. It enjoyed more rainfall, following the late Pleistocene pattern initially, and then changing to seasonal highland rainfall that "spilled over" into this narrow valley. The humid, and probably the transitional forest as well, were maintained in

part by condensed moisture from evapotranspiration falling at night as a fine rain. The seasonal forest in this region appears to have been consistently less xeric although it may have varied over time. The cyclical ENSO pattern was probably always less important but, as springs failed or became insufficient in the course of the Holocene and subsistence strategies shifted to irrigated agriculture, settlements were shifted closer to the valley floor.

The foraging data from the sites in the Q. Talambo and Q. del Batán suggest strategies of concentration on locally available resources. Among the plants are *algarrobo*, where the green pods may have been eaten, and the seeds of grasses that may have been ground on milling stones or *batanes*. There is heavy concentration on snails (*Scutalus*) and lizards (*Dicrodon*) for protein. Since both these species are herbivores and estivate through the dry season for several months to a year, these resources would not have been available year round (Maggard 2010; Stackelbeck 2008).

Data from Nanchoc show greater availability of resources and consequent greater breadth in foraging. One is struck by the evidence for non-domesticated fruits such as plum (*ciruela del fraile*) *Bunchosia*, *momil* (*Spondias*), blackberry (*Moraceae*), *tomatillo* or *capulí* (*Physalis*), hackberry (*Celtis*), and *pacay* (*Inga pacae*). There is also evidence for plants whose use may have been medicinal such as *Ilex* sp.; *Solanum nigrum*, nightshade; and *Eupatorium*, another medicinal (Rossen 1991; Stackelbeck 2008).The ilex remains are more varied as well. There are a few lizards, three species of snails, more small mammals, and more deer bone in the middens (Rossen 1991). This reflects the greater productivity of this environment.

ENTOMOLOGICAL INDICATORS FOR PALEOCLIMATE

Indirect evidence for the climate of the Nanchoc region during the latter part of the Las Pircas phase and possibly the transition to the Tierra Blanca phase comes from entomological evidence (see Appendix 1). The Cementerio de Nanchoc site (CA-09–04) consists of two earthen mounds and an adjacent activity area located on the lower portion of a broad alluvial fan on the north side of the Nanchoc Valley (see Chapter 7). In the course of the 1984–1985 excavations in Area B, the off-mound activity area at the site, a thick layer was encountered that had abundant round, hollow dark concretions about 1 cm in diameter. These were identified by Dr. James Carpenter, an entomologist working with the project, as casts made by beetle larvae that had entered the pupal stage underground. It is probable that the larvae lived in the soil, feeding on organic detritus.

It was not possible to identify the beetle to species, genus, or even to family on the basis of the casts. What was clear, as Dr. Carpenter pointed out, was that the environment must have been considerably wetter in the past than the environment today: savanna covered by sparse seasonal grass with shrubs and trees only in and beside intermittent watercourses (see Figure 3.9.) Subsequently, an even thicker layer of soil with dense beetle casts was encountered in excavations at CA-09–27, CA-09–28, and CA-09–52 by Rossen in Q. las Pircas on the south side of the Nanchoc Valley (1991). The same layer of soil was also encountered by Dillehay at CA-09–77 in the Q. Tierra Blanca (Dillehay, unpublished field notes). The dates recovered in the excavations at these five sites range from 8,200 to 7,000 years before the present (~9516–7683 BP). The majority of the dates fall between 8,000 and 7,200 years ago. The presence of these insects indicates wetter environmental conditions over a 1,400-year period in the early Holocene. The beetles could not survive the drier, more seasonal conditions that followed in this area.

STABLE CARBON ISOTOPE ASSAYS

Additional information comes from a series of stable carbon isotope assays on samples from Tierra Blanca sites in the Nanchoc basin and from early sites in the Q. del Batán and Q. Talambo in the Jequetepeque Valley. Plants using the C_3, C_4, and Crassulacean acid metabolism (CAM) photosynthesis pathways all create different values for stable carbon isotopes (Boutton 1996). The values recovered are suggestive and tend to reinforce the other ecological indicators. Tables showing the values obtained and a detailed discussion in terms of the sites are found in Appendix 3. The values recovered in the samples from Q. Talambo from sites dating to ~10,000 years BP ranged from ~27.3 to ~23.4, all firmly within the range of C_3 plants. This suggests that at that time conditions were mesic and not sufficiently arid to support either C_4 or CAM plants better adapted to semi-arid conditions. Unfortunately, there are no later samples that might reflect the more arid conditions of the Late to mid-Holocene (Appendix 3). The values for site JE-996, located at a somewhat higher altitude in the Q. del Batán, and somewhat earlier – ~12,000 to ~11,000 years ago – are consistent with these results, ranging from ~26.2 to ~23.9. This suggests that both areas had similar vegetation at this early period, despite their topographic differences.

The samples from the Nanchoc basin are somewhat later, falling between 7,500 and 6,500 years ago. The stable isotope values range from ~24.4 to

~20.4 for the sites in Q. Tierra Blanca. There is a lower value of –18.0 for CA-09–04 on the other side of the valley. All of these values fall within the range for C3 plants, although they are within the lower portion of that range. This may reflect somewhat more arid conditions (Appendix 3).

These results suggest that stable carbon isotope assays hold some potential for indicating broadly the type of vegetation found in the paleoenvironment of arid and semi-arid areas. Determining the stable carbon isotope values for the plants found within the area would be a necessary first step toward recreating the environment by this means.

CONCLUSION

It may seem counterintuitive to have to describe an essentially Holocene occupation of the valleys of the study region in terms of Pleistocene climate and biogeography. Nonetheless, by coming to grips with the long-term biogeographical history of northwestern South America, it has been possible to situate the intensive early human occupation of the tropical dry forests in the Zaña and Jequetepeque Valleys and the Nanchoc basin over the eight millennia between 13000 and 5000 BP. Setting aside the occupation of wetland environments, environments have not varied over this long period of time to the extent as did those inland. So long as archaeologists believed that humans had entered South America well after the end of the Pleistocene, the climate of that period was irrelevant for understanding human history. It is now clear that humans entered South America in the late Pleistocene.

In recent decades, geologists, physicists, oceanographers, palynologists, and others have provided a very different view of climate in the Pleistocene. Pleistocene climate was dominated by long cold periods during which the mountain tops and highest valleys of the Andean cordillera were covered by glaciers. The drop in atmospheric and ocean temperatures led to a descent of the tree line to below 2,600 m. Biologists and botanists have known for some time that areas of the humid montane forest that today are separated by considerable gaps once formed a continuous or nearly continuous band below the *paramo* (Dillon et al. 1995; Simpson 1975; B. Vuilleumier 1971). It has taken longer to come to an understanding that the wet montane forest formed a continuous or nearly continuous band from the southern part of the study area northward into Ecuador and beyond. Biogeographers and archaeologists have been slow to understand the key role played by the condensation of evapotranspiration from the forest trees in the maintenance of humid mountain forest under sometimes

arid Pleistocene conditions (Salati and Vose 1984). Each afternoon clouds formed over the wet forest at the head of the Zaña Valley, but it was only on entering the forest that the penetrating nature of this fine mist or *garua* became a reality (Figure 3.6). Because of this recycling of moisture, the wet montane forest is self-sustaining so long as it is not cut down. Its role in the maintenance of charged aquifers has yet to be assessed.

The density and visibility of the sites in the dry forest zones of Q. del Batán, Q. Talambo, and the Nanchoc Valley, which all lie below the humid montane forest on the western slopes, is constrained not by altitude but by available moisture. Taxonomists and biogeographers have traced the source of much of the dry vegetation of northwestern South America to immigrants from Central and North America thus providing both a lineage and an explanation for the similarities between the dry forests of northern Peru and western Ecuador and those of Colombia, Venezuela, and Panama (Gentry 1982, 1995; Sarmiento 1975). Piperno and Pearsall recognized a decade ago the importance of the dry forest for early foragers at the end of the Pleistocene (1998).

Many of the Pleistocene wetland environments, particularly back swamps and estuaries, perforce must have moved as sea levels rose at the end of the Pleistocene and through the early Holocene and the shoreline moved eastward. Freshwater ponds or *puquios*, were dependent on the water table and possibly flooding from the river. These wetlands were probably more stable until affected by decreased water flow from groundwater and intermittent streams. Nonetheless, they were secure environments, even if mobile over the very long run.

The terminal Pleistocene populations who made their way southward through Central America had mastered the potential of the dry forest to sustain opportunistic foragers as well as that of the humid forest (Cooke 1998; Cooke and Ranere 1992; Piperno and Pearsall 1998; Ranere and Cooke 2002). It would appear that as they entered South America, some early groups moved eastward along the dry forest of the Caribbean coast. Others may have moved southward through the dry forests of the Pacific Coast into Ecuador and ultimately northwestern Peru (Gentry 1982, 1995; Piperno 2007; Sarmiento 1975). Rather than coming into a new country where strange resources presented a constant challenge, early peoples moved through a rich, varied, and well-known biozone (Kelly and Todd 1988). The demise of the Pleistocene megafauna, where people had entered before the end of the Pleistocene, did not adversely affect the ultimate success of these populations. The richness and visibility of the archaeological record in the dry forests and wetlands between the Zaña and Chicama

valleys has opened a new chapter in our understanding of the initial success of these populations in these environments. The further early development of horticulture in the Nanchoc basin was made possible by the favorable dry forest environment in that valley, which provided a basis for the subsequent expansion into irrigated agriculture.

CHAPTER FOUR

El Palto Phase (13800–9800 BP)

Greg Maggard and Tom D. Dillehay

The archaeological record of the late Pleistocene period of the New World, between 14,000 and 11,000 years ago, represents the continued spread of human groups into many previously unoccupied or unavailable areas of the North and South American continents (Bryan 1991; Dillehay 1999, 2000a,b; Lavallée 2000; Meltzer 2009; Rothhammer and Dillehay 2009). As this colonization of new environmental zones occurred there was a concurrent rise in the diversity of mobility, subsistence, and technological strategies pursued by early populations (Borrero 1996; Kaulicke and Dillehay 1999a,b; Maggard 2010; Politis 1991). Nowhere is this pattern more evident than in western South America where several coterminous or overlapping complexes, including the Fishtail, Paiján, and several other bifacial and unifacial complexes, have been documented. As for Peru and the study area, it was probably first populated by way of a coastal route along the Pacific shoreline or from the crest of the nearby Andean highlands sometime before 13000 BP.

An abundance of new literature exists on the first peopling of the Americas, which will not be reviewed here. However, for the purpose of situating our database within this broader literature, we make a few brief introductory comments. We recognize that the distinct adaptive modes associated with Fishtail, Paiján, and other lithic industries may be related to different strategies of colonization. For instance, Beaton (1991) and others have posited a model of colonization strategies that emphasizes two distinct forms of social organization (cf. Dillehay 1997b; Dixon 1999; Maggard 2010). These modes include small, highly mobile groups (e.g., transient explorers) rapidly colonizing a landscape through the redundant use of a limited number of key resources and formal, curated technologies. Social groups fission frequently and at low numbers, which

fosters rapid dispersion – along with low fecundity and high risk of failure. Specific knowledge of the landscape is low and is expressed in relatively ephemeral occupations. Another strategy involves small groups (e.g., estate settlers) who spread slowly throughout a given landscape with longer term, repeated occupations of highly productive ecological niches. These groups make more intensive and regionalized use of a wider range of resources and demonstrate a more flexible technological adaptation. Social fissioning is less common and occurs when the local carrying capacity has been exceeded or social tensions are high. Splinter groups maintain close ties with previous groups for economic support and social interactions.

Different strategies illustrate how variability in the rate and type of colonization, selection and intensity of resource use, and knowledge of the local landscape could result in significantly different archaeological signatures for contemporaneous early colonizing groups (e.g., Beaton 1991; Meltzer 2002, 2009). However, to characterize distinct strategies of early colonization in the Andes, we must understand the mobility or lack of mobility, subsistence, and technological organization of the coterminous groups within a region. In this study, the Fishtail and Paiján complexes of northern Peru are discussed in terms of differences in their mobility, subsistence, and technologies that are believed to represent distinct colonizing strategies. Fishtail groups are believed to be more representative of a short-term, ephemeral, transient pattern, while the Paiján sites correlate more closely with a regionalized settling-in strategy. Although far from conclusive, these modes may provide new avenues for understanding processes of early peopling and organizational diversity during the late Pleistocene and early Holocene period. Collectively, we refer to this process in the study area as the El Palto phase, with the pre-Paiján period termed the El Palto subphase (ca. 13800–11700 BP) which includes the Fishtail complex; this is followed by the early Paiján and late Paiján subphases. These subphases are distinguished primarily by a few diagnostic lithic tool forms, but also to a lesser degree by the absence and presence of stone-lined domestic structures, respectively.

To provide a better understanding of the social and organizational processes associated with the El Palto phase in the study area, intensive survey and excavation of early Preceramic sites were specifically conducted by Maggard in the Q. del Batán during 2002 to 2003. The Q. del Batán is located approximately 25 km east of the Pacific Ocean, between the Zaña and Jequetepeque valleys, and is situated in the low foothills of the

western flanks of the Andes. (Prior to this period sixty-two late Pleistocene sites had been recorded by the Zaña and Jequetepeque valley projects described in Chapter 2 [Dillehay and Kolata 1999; Dillehay et al. 1989, 2003, 2009; Dillehay and Netherly 1983; Rossen 1998, 1991; Rossen and Dillehay 1999] and by the Cupisnique project of Chauchat farther south [Becerra 1999; Briceño 1997, 1995; Chauchat 1982, 1988, 1998; Gálvez 1992, 1999].) As a result of the recent work, 223 new sites were recorded in the area, 113 of which have been identified as El Palto phase sites based on diagnostic cultural materials, and include both the Fishtail and Paiján complexes, along with several unidentified unifacial sites. Analyses of the data collected from sites in the Q. del Batán suggest that gradual adaptation to the tightly compacted micro-environmental zones of the study area fostered differing strategies of mobility and subsistence between Fishtail and Paiján groups between 13,800 and 9,700 years ago (Maggard 2010).

Within the Central Andes, few sites yielding Fishtail projectile points have been documented. The El Inga site in Ecuador (Bell 1960, 2000; cf. Dillehay 2000a; Mayer-Oakes 1986a, 1986b), La Cumbre in the Moche Valley (Ossa 1978; Ossa and Moseley 1972), and two sites identified by Briceño (1995, 1997, 1999) in the Q. Santa Maria in the Chicama Valley are the best-known examples of Fishtail sites in the Central Andes. The Fishtail complex has been believed to represent the southern extension of the North American Clovis culture, although no solid data exist to support this assertion. In addition, the Fishtail complex has been characterized as ancestral to the Paiján complex; however, the marked differences in settlement pattern and technology from coterminous or overlapping occupations argue against such affinity. Fishtail sites, in general, are ephemeral and sparse. Because very few sites have been excavated, radiocarbon dated, and subjected to settlement/subsistence analysis, our understanding of the Fishtail economy and technology is severely limited. The few radiocarbon dates we have in the Central Andes are wide ranging and, to date, have limited any precise chronological understanding of Fishtail adaptations (Bell 2000; Chauchat 1988; Dillehay 2000a; Ossa 1976).

The Paiján complex, dates from ~13,000 to 9,800 years ago (Chauchat 1988: 47–59; Dillehay 2000a: 149–150). Numerous Paiján sites have been investigated, and they represent the most clearly understood El Palto phase complex. Paiján lithic technology also is distinct from that of the Fishtail complex and contains both bifacial and unifacial tools that are

occasionally associated with groundstone implements, suggesting a wide-spectrum economy (Chauchat 1982; Malpass 1983; Mayer-Oakes 1986a, 1986b; Ossa 1978).

Chauchat (1988, 1998) has characterized the Paiján complex as an early coastal adaptation, primarily to maritime resources, in which groups moved from littoral zones through the coastal plain into the lower foothills and quebradas of the Andes on a cyclical basis. However, the intensity of Paiján occupation within the coastal and mountainous quebrada systems in the Zaña to Jequetepeque region (Dillehay et al. 2003), where a mosaic of micro-environmental zones existed (Tosi 1960; see Chapter 3), combined with the broad spectrum of plant resources reported by Dillehay and Rossen from late Paiján sites in the Zaña Valley (Dillehay et al. 1989; Rossen 1991; Rossen et al. 1996), indicates that the Paiján economy represents more than semispecialized coastal fishers (Briceño 1999; Dillehay et al. 2003; Gálvez 1992; Malpass 1983). Eleven Paiján sites in the Q. del Batán area have been excavated and yielded a wide variety of lithic, faunal, and floral materials. These sites, along with many others, suggest that the Paiján represent an intensive, generalized foraging strategy centered on the broad spectrum of plant and animal resources, including cultivated squash (Dillehay et al. 2007) that were immediately available in the coastal quebrada systems.

EL PALTO SUBPHASE (~13800–11700 BP)

Fifty-one sites were categorized as belonging to this subphase, which is comprised of early radiocarbon dated buried deposits such as the El Palto site located in the lower dry tropical forest in the Nanchoc Valley; unifacial lithic sites identified as Amotape- and Siche-related and located in the ancient delta of the Carrizal drainage south of the Purulén hills; Fishtail point sites located primarily in the Q. del Batán, Q. Talambo, and Q. Cupisnique; and a wide variety of both early and late Paiján and unifacial sites found primarily in the coastal foothills and desert plains but not along the littoral zone and not yet in the higher elevated areas of the study area (Fig. 4.1). Each of these site clusters is described briefly below.

Buried Unifacial Preceramic Sites: El Palto and eleven other buried Preceramic sites were recorded during surveys in 1977 and 1985 in the Niepos, Nanchoc, Florida, and Monteseco areas of the upper middle Zaña Valley. All of these sites are multicomponent localities characterized by intact

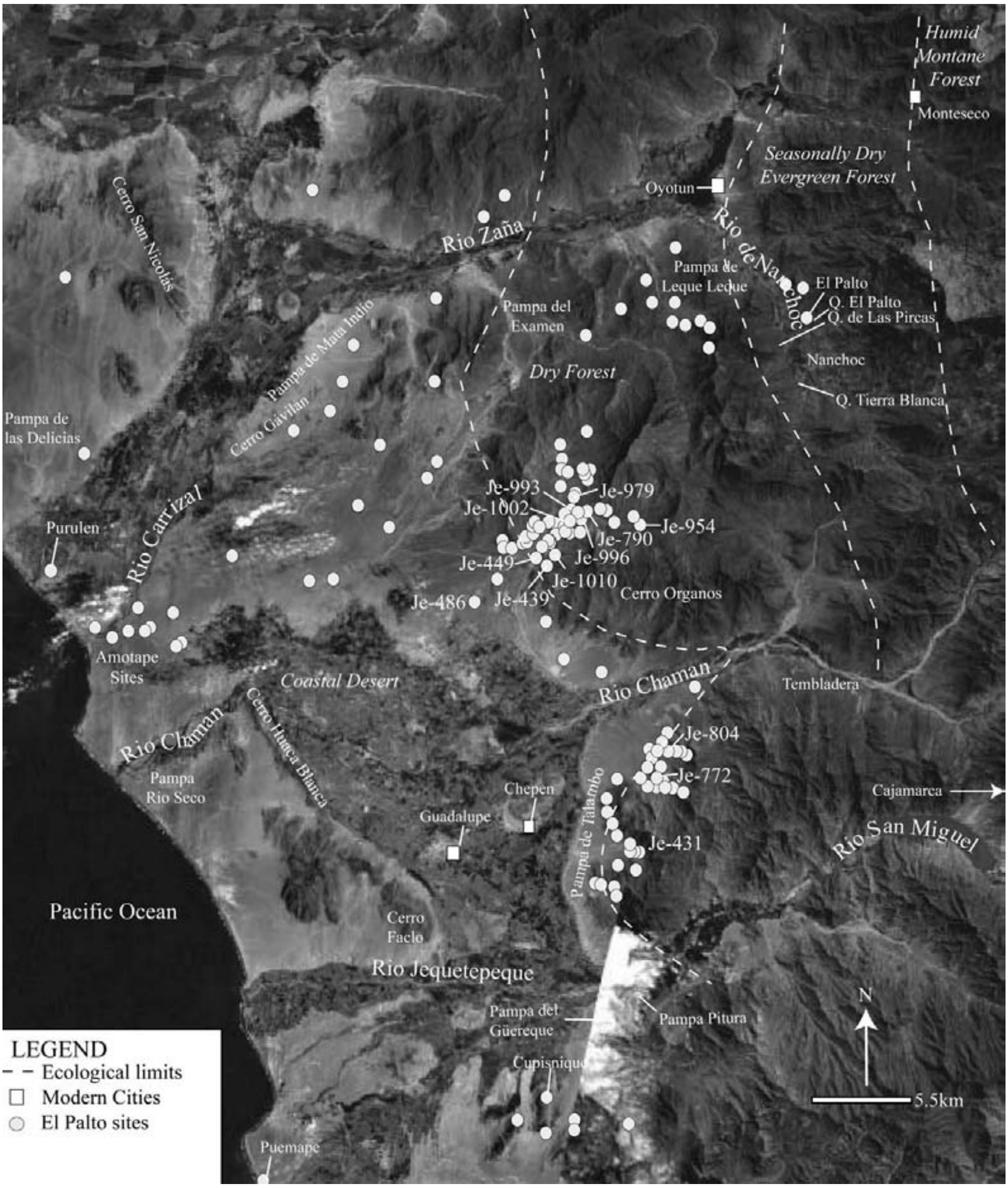


Figure 4.1. Location of El Palto phase sites in the study area.

stratigraphy with the Preceramic levels exposed by road and/or drainage cuts. El Palto is a relatively small site (~0.5 ha) buried ~1.6 m below surface in the south terrace of a stream down-cutting the southside of the Niepos plateau in the Nanchoc Valley (Fig. 4.2). Excavation of a drainage cut revealed that the upper 1m is composed of ceramic layers and the lower 60 cm of Preceramic material, including small to moderate unifacial flakes made of basalt and andesite, charcoal lenses, and possible hearths.

Figure 4.2. General view of the El Palto site in the dry forest of the Nanchoc Valley.

The deepest charcoal lens was radiocarbon dated to 13178–13859 BP (Beta-38992). The lithics are unifacial flakes and waste debris made of quartzite, quartz, rhyolite, toba, and tuff. Similar types of sites have been identified in the Carahuasi, Monteseco, Florida, and Udima areas of the upper Zaña Valley and possibly represent seasonal transhumant foragers occupying different niches of the middle and upper slopes of the valley. All of these sites are situated in dry to humid forested areas and next to streams and active springs on the mountain slopes. Most of these sites represent ephemeral short-term field camps, although a few of the larger and later ones are short-term base camps in the forested setting of the higher elevated zones.

Surface Unifacial Sites: Eleven sites defined by lithic scatters are found in the late Pleistocene and early Holocene delta of the Zaña River, which is the Carrizal drainage that lies due south of the Purulén hills and ~0.5 to 2.5 km inland from the present-day coastline (Figs. 4.3 and 4.4). The terrain where these sites are located varies generally as a function of wind deflation, hard-pan desert compaction, and location near the drainage bottom where water once flowed. All sites are located on the desert floor of terraces and low knolls flanking the dendritic drainage pattern of the Carrizal delta. The elevation of all sites above the drainage floor is between 10 and 15 m. The size of these sites is quite small, ranging from 100 to 700 m^2 in size. The lithics consist of large to medium size flakes made of quartzite and basalt, a few hump-backed unifacial tools, and miscellaneous discard

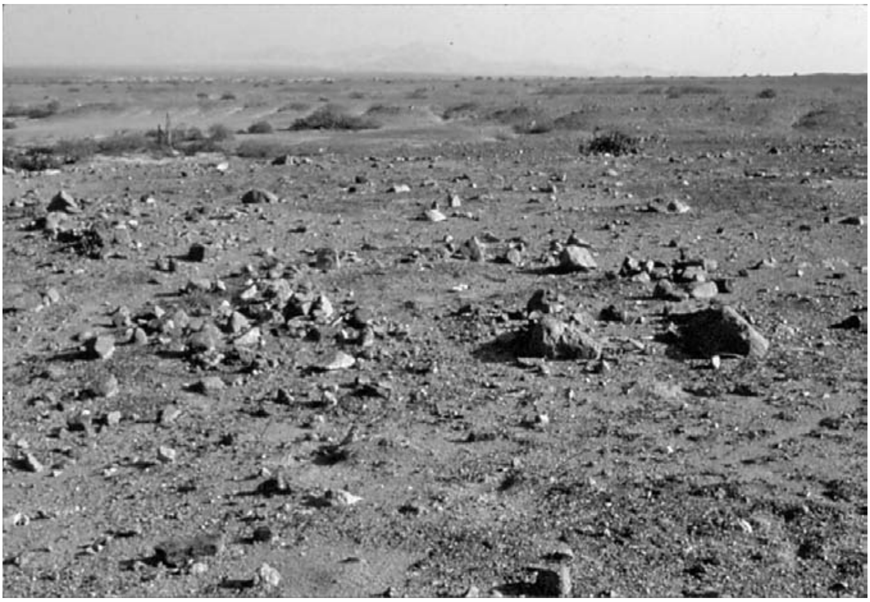


Figure 4.3. General view of an El Palto phase site showing delated and scattered lithic and rock debris in the Carrizal delta. The vegetated floor of the present-day Zaña Valley is in the distant background.

debris. Most of the lithics are dark in color and exhibit a heavy desert varnish, indicating exposure to wind and radiation for a considerably long period of time. Shovel tests placed at four sites indicate no intact subsurface deposits. The closest morphological analogy to this stone assemblage is the Amotape tradition defined by Richardson (1969, 1978, 1981) in the Talara-Amotape area of far north coast Peru and dated between 12,300 and 9000 BP. Based on this similarity and on the location of these sites in the older, abandoned channel of the Zaña River, which Mario Pino (personal communication, 2000) estimates to date in late Pleistocene to early Holocene times, we place the time of Carrizal sites to be between 12,500 and 10,000 years ago. No windbreaks or domestic stone-lined architectural structures are associated with these sites. Most appear to be short-term field camps.

Located on the south side of the Zaña Valley in the center of a large alluvial fan, Pampas de Mata Indio, are three southeast to northwest oriented *yardangs*. They range in size between 60 to 120 m in length, 30 to 65 m in width, and 15 to 22 m in height. (*Yardangs* are streamlined erosional wind formations often in the shape of reverted boats, which develop in areas with poor vegetation cover due to aridity. Their azimuths are not always formed by the prevailing wind direction today but by a unidirectional wind in the past. In the lower Zaña Valley, erosion is facilitated by

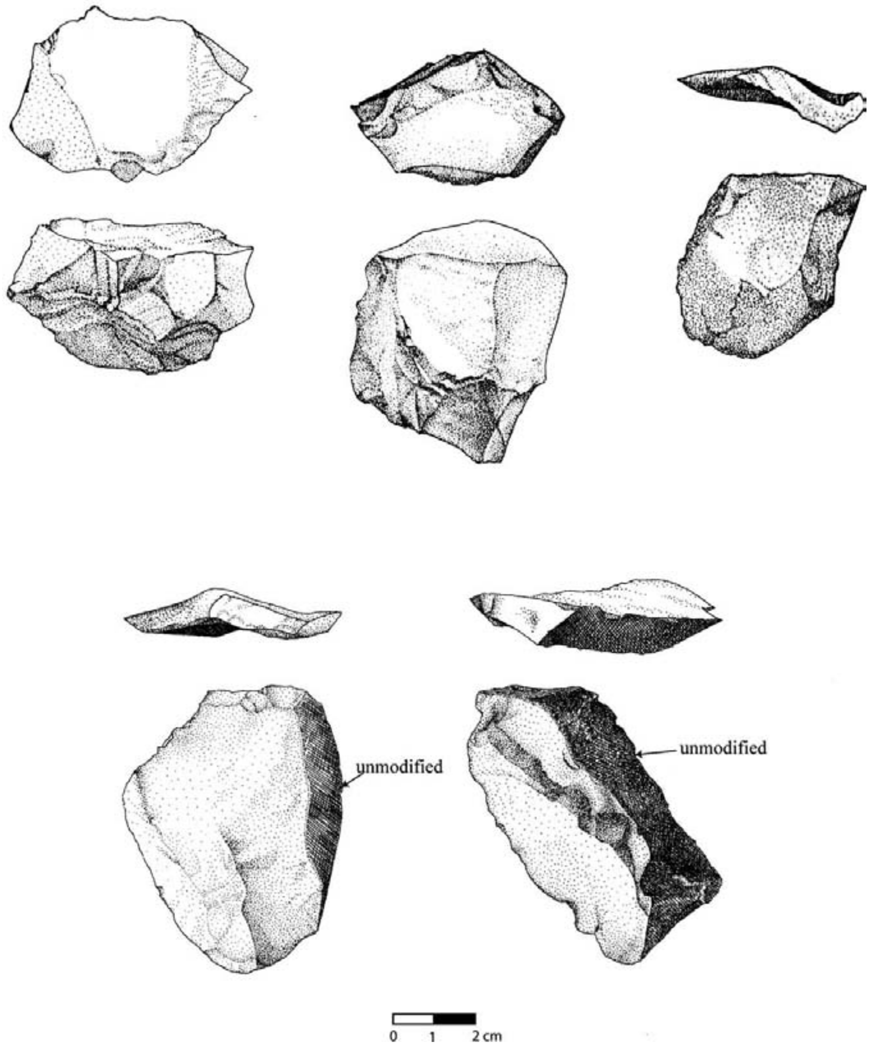


Figure 4.4. Unifacial tools of sites in the Carrizal delta.

available quartz sand particles acting as abrasive agents.) Various unifacial lithics reminiscent of Amotape flakes and miscellaneous debris appear on the dark, hard pan desert surface of these features. The lithics show the same dark desert varnish as those in the Carrizal area. Also present are a few roughly circular hearths formed by angular rocks. These sites appear to be short-term campsites associated with an older landscape surface that once formed part of the valley floor. Curiously, several Paiján sites are located on the lower elevated, present-day valley floor, within 500 m of the sites on top of the mesa features; lithics at the Paiján sites are not varnished by solar radiation and wind polish. We estimate the time of the *yardang* sites to be between 12,000 and 11,000 years ago.

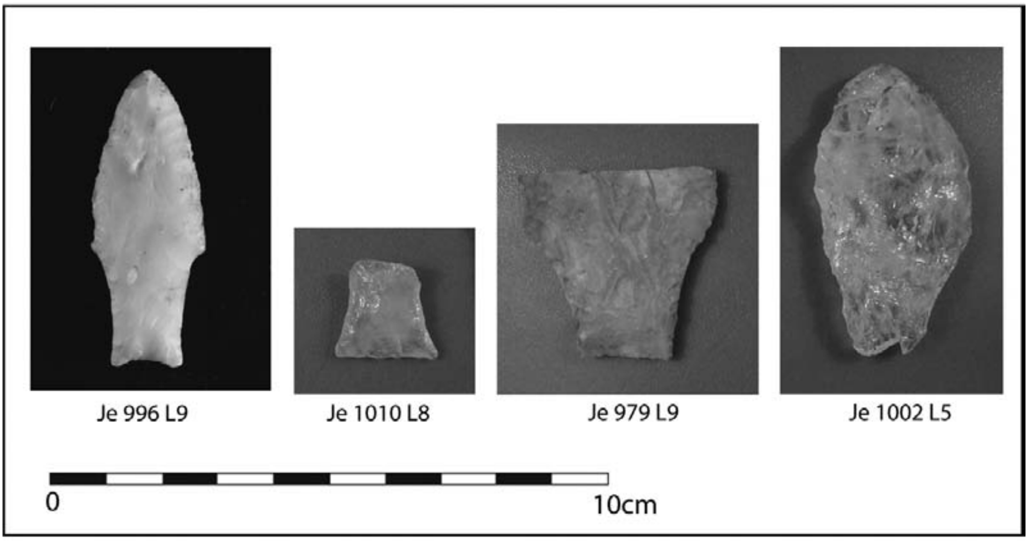


Figure 4.5. View of Fishtail projectile points recovered from sites in the Quebrada Batán.

Fishtail Point Sites: Within the Central Andes, few sites yielding Fishtail projectile points have been documented. The El Inga site in Ecuador (Bell 2000, 1960; Mayer-Oakes 1986a,b), La Cumbre in the Moche Valley (Ossa 1978; Ossa and Moseley 1972), the high altitude Laguna Negra site (3,775 masl) in northern Peru (León et al. 2004), two sites identified by Briceño (1995, 1997, 1999) in the Q. Santa Maria, and four sites identified in the Q. del Batán of the lower Jequetepeque Valley (Fig. 4.5 shows Fishtail points from Q. del Batán sites; Maggard 2010) are the best-known examples (JE-979, JE-996, JE-1002, JE-1010; see Fig. 4.6). Fishtail technology has been suggested as a possible ancestor to the Paiján complex; however, the marked differences in settlement pattern, mobility, and technology from contemporary/overlapping occupations argue against such affinity.

Fishtail sites, in general, are ephemeral and sparse and appear to be short-term field camps. No Fishtail quarry or processing sites were found. Because very few sites have been excavated, radiocarbon dated, and subjected to settlement/subsistence analysis, our understanding of Fishtail economy and technology is limited. Fishtail points from western South America and Central America generally date from ca. 12800 to 12000 BP (Bell 2000; Cooke 1998; Dillehay 2000a; Dillehay et al. 1992; Politis 1991; Suárez 2003). Dates from Fishtail deposits within the lower Jequetepeque Valley indicate a somewhat more restricted time frame of regional occupation (~12100–11500 BP). In the Q. del Batán, three new sites containing Fishtail points were recorded and excavated, one of which – site JE-996 – has been radiocarbon dated to between 12,800 and 11,300 years before present,

Figure 4.6. View of site JE-1002 where both Fishtail and Paiján points were found.

which overlaps with the early Paiján occupation of the region (~13100 to 11200 BP; see Appendix 1). The relatively few known Fishtail sites in the north coast region are suggestive of ephemeral occupations by small, highly mobile groups with a formal, curated technology that is, overall, remarkably similar across southern and western South America (Borrero 1996; Miotti 2003; Politis 1991).

Fishtail points recovered from across northern Peru (Q. del Batán, Q. Santa Maria, La Cumbre, and Laguna Negra) are similar in size (approximately 5–6 cm in length). Interestingly, these points are also similar in size to Fishtail points from the Fell's Cave type site and other sites in Argentina, Uruguay, and Ecuador – which average 4–7 cm in length (Bell 2000; Bird 1969; Politis 1991, Table 2; Suárez 2001, 2000). Aside from the similarities in size, however, there exists a relatively wide range of morphological variability between Fishtail points from both similar and different regions. At present, however, we lack a basic understanding of the range of morphological variability and what this intra- and inter-regional variability may indicate about technological changes or functional differences.

Raw materials used in the manufacture of Fishtail points further suggest a pattern of limited occupation of the region. All of the points and fragments identified in Q. Santa Maria were manufactured from quartz crystal, as were two of the points from the Q. del Batán (Maggard 2010).

Figure 4.7. View of a stone-lined hut structure of late Paiján age at PV-19–65.

The remaining points in the Q. del Batán assemblage were manufactured from nonlocal silex and chalcedony that outcrop to the east in the Andean highlands. Similarly, the point from Laguna Negra was manufactured from jasper, which also outcrops in the highlands. The point from La Cumbre is reported as manufactured from "chert," which is also probably a highland silex variety (Ossa 1978). The common use of nonlocal materials and limited use of local materials likely indicates a relatively high mobility, and coarse-grained use of the Zaña-Jequetepeque region.

Paiján Sites: The Paiján complex, which dates from 13,000–9,800 years ago (Chauchat 1988: 47–59; Dillehay 2000a: 149–150; Dillehay et al. 2003), is known primarily from the lower sections of the Zaña, Jequetepeque, Cupisnique, Chicama, Moche, and Casma valleys of northern Peru (Briceño 1997, 1995; Chauchat 1982, 1988; Chauchat et al. 1998, 2006; Gálvez 1992; Malpass 1983; Ossa 1976, 1978; Ossa and Moseley 1972; Rossen and Dillehay 1999). Ninety-eight Paiján sites have been studied. Paiján settlement, which was widespread, indicates relatively long-term, repeated use of areas that provided access to multiple kinds of resource zones, like the dry forest quebradas of the lower, western Andean flanks. Late Paiján sites (~11300–9800 BP) occasionally contain domestic structures and activity areas, suggesting greater localization and perhaps an incipient territoriality (Figs. 4.7, 4.8) – indicating a mobility pattern that was very different from that of the Fishtail.

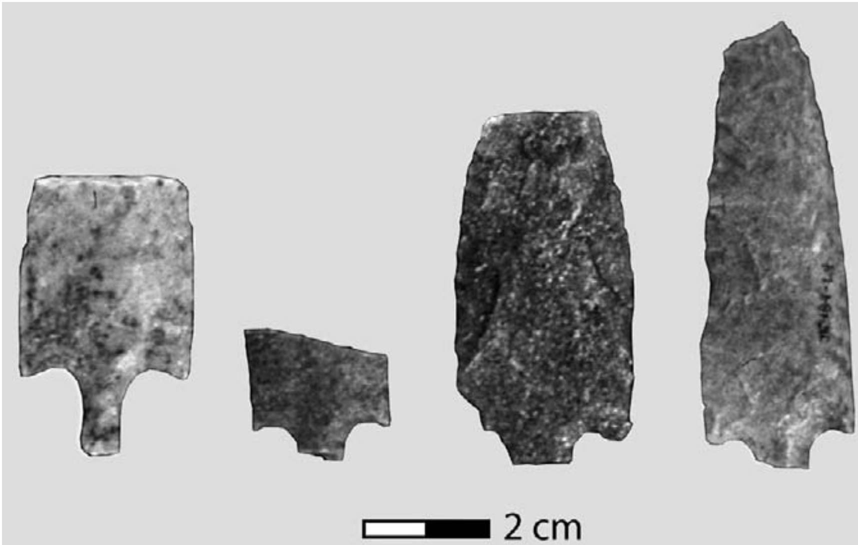


Figure 4.8. Paiján projectile points recovered from sites in the Zaña and Jequetepeque valleys.

Several late Paiján sites within the lower Zaña and Jequetepeque valleys contained stone-lined, domestic structures that average 2–4 m in diameter (Dillehay et al. 2003; Maggard 2010). These structures, which appear to represent the stone foundations for a superstructure of perishable materials (plants or hides), are often associated with dense clusters of lithic debris and tools, including Paiján projectile points (Fig. 4.8, 4.9). Similar projectile point and structure associations have been reported by Gálvez and Becerra in the Chicama valley and by Dillehay in the Zaña and Jequetepeque regions (Dillehay et al. 2003; Gálvez 1990; Gálvez and Becerra 1995; Rossen and Dillehay 1999). Radiocarbon dates from several of these structures in the Zaña-Jequetepeque region, range between ~11300–9800 BP (Dillehay et al. 2003; Stackelbeck 2008). These kinds of associations are strong indicators of reduced mobility and settlement localization by the Paiján. Localization and reduced mobility by the Paiján suggests regionalized subsistence practices and a more intimate knowledge of the local landscape than the contemporary Fishtail occupations.

Paiján lithic technology also is distinct from that of the Fishtail and contains both bifacial and unifacial tools (including a range of formal unifacial types) that are associated with groundstone implements, suggesting a wide-spectrum economy (Chauchat et al. 1998, 2006; Maggard 2010; Malpass 1983; Ossa 1978). Briceño (1997) has noted that Fishtail lithic assemblages typically emphasize the production and curation of portable, reusable, bifacial tools. Bifacial production is still prominent in Paiján assemblages, but

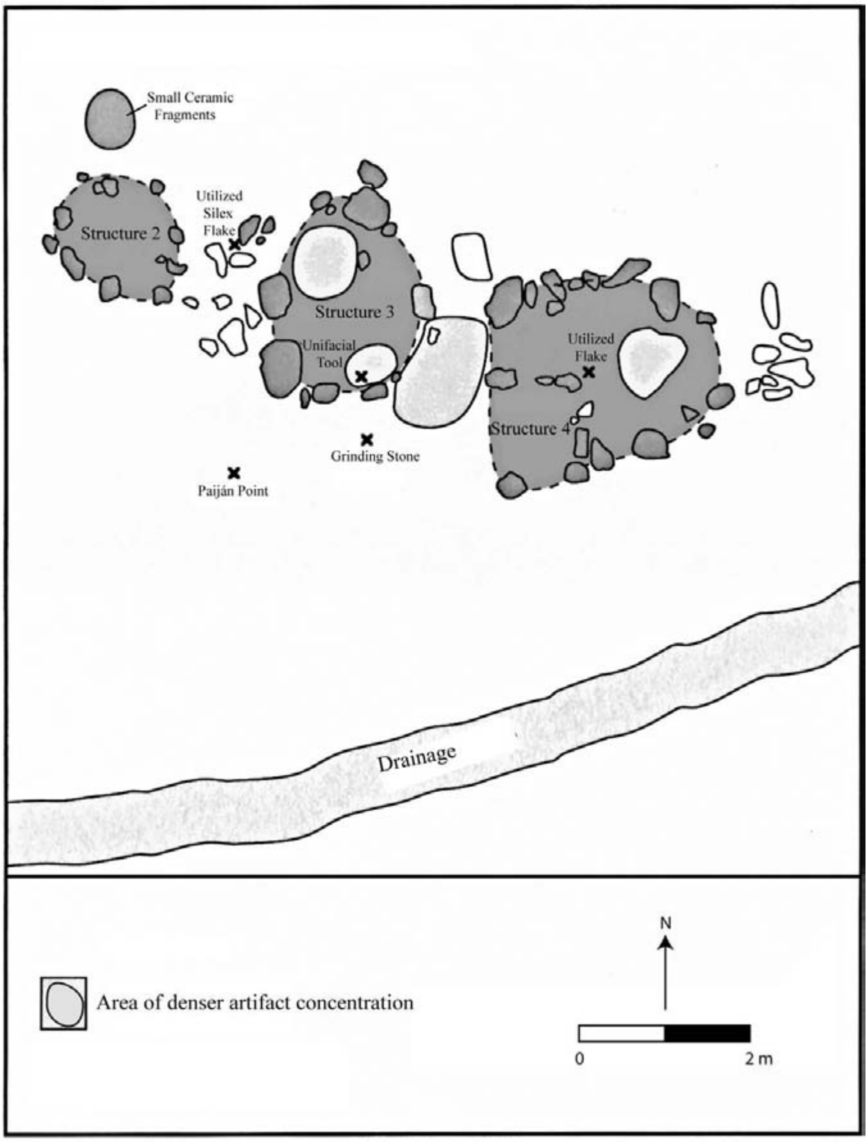


Figure 4.9. Plan of Paiján structures at site JE-43.

is also evidences increased use of a variety of formal unifacial, expedient unifacial tools (Fig. 4.10) and groundstone – which likely indicates diet diversification and the rising importance of plant resources (Dillehay 2000a; Dillehay et al. 1989; Lavallée 2000; Maggard 2010; Piperno and Dillehay 2008; Rossen 1998, 1991; Stackelbeck 2008).

Analysis of raw materials from the sites in the Q. del Batán also supports a pattern of reduced mobility for the Paiján. Fishtail points collected in Q. del Batán were more frequently manufactured from nonlocal, highland raw materials and probably suggest wide-ranging mobility. Paiján tools, in

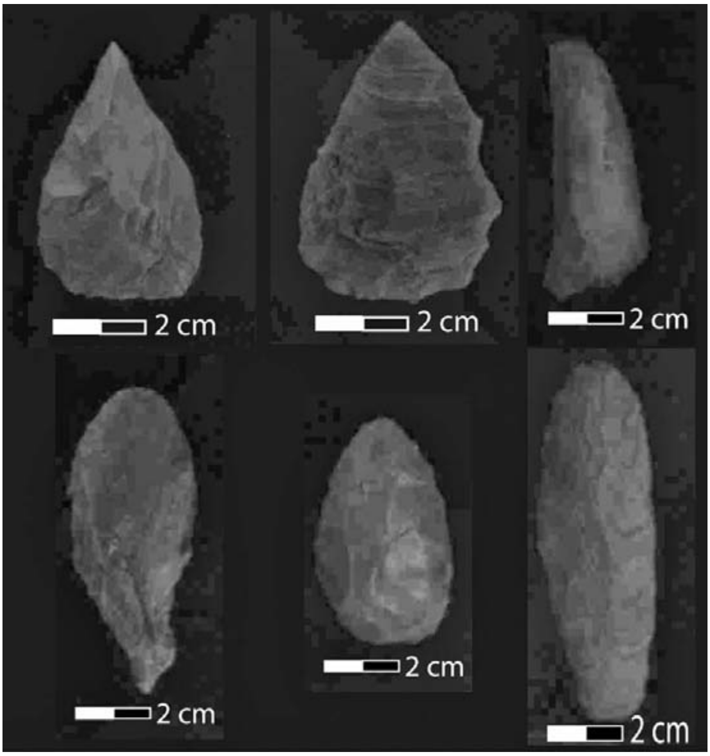


Figure 4.10. Paiján limaces and unifacial tools.

contrast, were manufactured almost exclusively from locally available raw materials, including quartz, quartzite, rhyolite, and basalt, with few to no exotic materials present. The relative absence of nonlocal raw materials in Paiján assemblages, combined with the indications of plant processing and the presence of domestic structures, further indicates distinct patterns of technology, settlement organization, and mobility between the Fishtail and Paiján.

The Paiján economy likely represents more than semispecialized coastal fishers (Briceño 1999; Dillehay et al. 2003; Gálvez 1992; Malpass 1983): consider the intensity of Paiján occupation within the coastal and mountainous quebrada systems in the Zaña-Jequetepeque region (Dillehay et al. 2003; Maggard 2010), where a mosaic of dry grassy and forested micro-environmental zones existed, combined with the broad-spectrum of plant resources, including squash remains (*Cucurbita moschata*) dated at ~10000 BP, reported by Dillehay and others from late Paiján sites in the Zaña Valley (Piperno and Dillehay 2008; Dillehay et al. 1989; Rossen 1991; Rossen et al. 1996). The presence of waisted hoe-like implements at a few late Paiján sites in the upper Q. del Batán may be indicative of planting and cultivating squash or perhaps other crops (see Chapter 11).

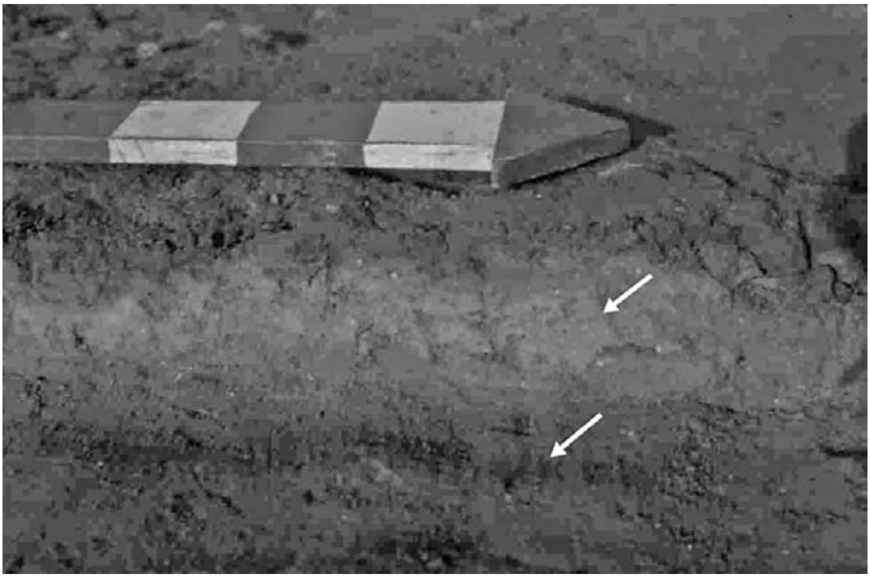


Figure 4.11. Thick continuous occupational floors with hearth (arrows) in a late Paiján structure.

Excavated Paiján sites in the lower Jequetepeque yielded a wide variety of lithic, faunal, and floral materials. These sites, along with data from across the north coast region, suggest that the Paiján economy is probably best characterized as an intensive, broad-spectrum foraging strategy centered on the plant and animal resources that were immediately available in the dry forests of the lower elevated quebradas.

Based on radiocarbon dates, the presence or absence of stone-lined architectural structures at sites, and the thickness and continuity of floor deposits inside these structures, the Paiján complex was divided into two subphases. The early subphase roughly radiocarbon dates between 13000 and 11200 BP and is not generally associated with architecture. The late subphase dates between 11300 and 9800 BP and is often associated with stoned-lined domestic structures. This does not imply that all Paiján sites with structures date to this later time period and that those without structures are earlier. Rather, this is a tentative pattern we have observed and requires further testing based on more data. The early sites appear to be short-term field campsites (JE-431, JE-439, JE-804), although a few maybe short-term base camps too.

Sites of the latter part of the late subphase (~10500–9800 BP) often have between four and eight architectural structures and thicker, more continuous floor deposits ranging in thickness from 10 to 25 cm (Fig. 4.11). This same type but thicker floor sequencing is characteristic of the later

Las Pircas and Tierra Blanca phase structures, but the floor deposits in these later sites often are 30 to 40 cm in thickness. However, not all late Paiján sites have structures (e.g., JE-431, JE-439, JE-449, JE-772), but many do. The structures are slightly larger than the earlier ones and range in diameter between 2.2 and 3.1 m. They are occasionally agglutinated and arranged linearly along the ridge or crest of alluvial fans near water sources. The late Paiján sites represent long-term base camps. Those sites associated with the cultivation of squash (i.e., *Cucurbita moschata*) maybe horticultural residences with small garden plots. This location represents a settlement shift to the middle portions of alluvial fans where small seasonal and/or perennial streams are accessed more directly. The cultivation of squash may also reflect the need to inhabit places with fertile soils and access to running water for small-scale crop production. Excavated hut floors also reveal a higher and more diverse quantity of fauna and flora materials, as well as small hearths and lithic and other debris, suggestive of a more intensive and prolonged use of the site. Concentrations of lithics and burned rock are usually found scattered outside and between these structures.

Structures of the early part of the late subphase (~11300–10500 BP) often are associated with thin, intermittent floor sequences interrupted by brief periods of abandonment (Fig. 4.12). The individual floors in these sequences range in thickness from ~2 to 4 cm and are defined by six to eight individual occupational lenses that are organic and contain ash, charcoal, lithic debris, and occasionally bone and plant material, when preserved. Small amounts of charcoal and fauna and lithic debris are found in these lenses indicating ephemeral occupations. The intervening micro-strata are thin lenses of culturally sterile soil revealing a pattern of cyclical reoccupation of the structures, probably on a seasonal basis, and abandonment. Located outside of the structures are light scatters of lithic debris. These sites are often located on flat areas near edges of terraces close to quebrada streams.

Clearly, a notion of establishing a more permanent base camp is represented by the structures associated with the late Paiján subphase. These structures depict different degrees of permanence whether they were seasonal or yearly in nature. In comparison, no structures and no relatively thick or even intermittent occupational deposits were associated with the excavated Fishtail, early Paiján, and early Carrizal and *yardang* unifacial sites. The sizes of the late Paiján structures are suggestive of small "proto-households," which were repeatedly used (Dillehay et al. 2003). Those structures having thicker floor deposits at the end of the late Paiján subphase are similar to those of the subsequent Las Pircas phase and probably

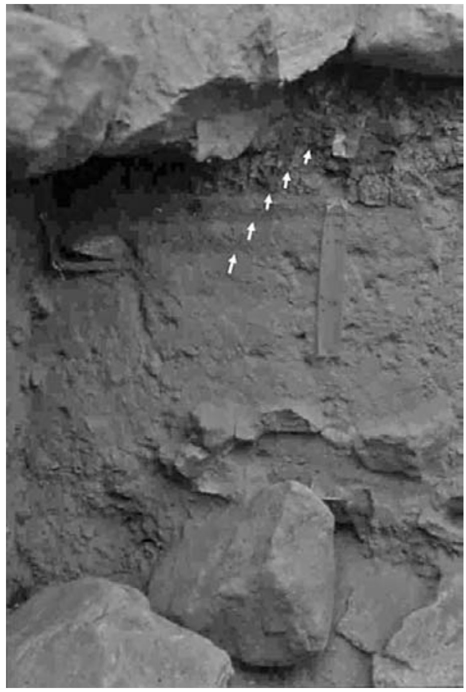


Figure 4.12. Excavated floors (arrows) in early Paiján structure showing periods of occupation (dark bands or floors) and abandonment (light bands).

represent the transition into a true household functioning as a home base, which is evidenced by a higher degree of permanency, a wider variety of expedient tools, exclusive use of local raw materials, thicker house floors indicative of longer stays, reliance on more cultigens, and more intensive activities.

Contrary to Chauchat's (1987) idea that the Paiján projectile points were used to spear fish, we have not found any Paiján points or sites within 10 km of the present-day shoreline. This distance becomes even more pronounced when we consider that the shoreline was at least 20 km farther west during the late Pleistocene period (Richardson and Sandweiss 2006). All of our evidence indicates that Paiján sites were adapted to the springs and xeric to mesic vegetated areas of the lower slopes of the Andean foothills, probably with seasonal resource forays to the nearby shorelines, coastal estuaries, and plains.

Last, no early littoral sites were found in the study area. If late Pleistocene once existed along ancient shorelines, today they are submerged below many meters of water and at least 20 km farther west of the present-day littoral zone.

AFTERTHOUGHTS

The problem of what economic adaptations were made to changing ecological conditions by the first inhabitants of the study area is more important to this volume than the questions of chronology and the date of initial entry of people; however, the two problems are closely interrelated because of certain assumptions held by many archaeologists. It has been recognized by archaeologists working in the region that there probably was no actual evidence to support the assumption that specialized big game hunting was ever a dominant activity along the western slopes and coastal plains of the north coast of Peru (Briceno 1995, 1999; Dillehay 2000a; Galvez and

Becerra 1999; Ossa and Moseley 1972). Nevertheless, an early period of specialized hunters, characterized by Fishtail points, has been assumed to predate all bifacial and stemmed point (i.e., Paiján) assemblages, although there are presently no hard data to support this assumption. On the contrary, the evidence suggests that Fishtail and early Paiján cultures were contemporary.

It is our position that all assumptions relevant to the span of time covered by the El Palto phase should be established as working hypotheses subject to confirmation, refutation, or modification using actual data available within the north coast area, instead of employing models based on evidence found elsewhere. For instance, consideration of radiocarbon dated sites often containing unfacial tools and both Paiján and Fishtail projectile points cast doubt on whether these diagnostic tool phases really are valid concepts, either as technological and economic stages or time periods, at least in our study area. Some progress in separating these stages and periods has recently been made by Maggard's (2010) detailed analysis of more than 200 early sites in the study area, which shows both overlapping and distinct traits for each of these industries. Both our previous research on this topic, as well as Maggard's work indicate that broad-spectrum foragers colonized the area at least 12,000 years ago and intensified and broadened their diet as they gradually settled into specific ecological zones. However, there is no evidence to continue to support the assumption that these industries are descendants of an earlier specialized hunting economy.

Last, in the light of the objectives of this book, we could even question whether it is useful to maintain any arbitrary distinctions between late Pleistocene and early Holocene adaptive strategies in the study area. We say this because the current evidence for this period, but especially the early Holocene, suggests that there were ongoing frequency shifts in the use of alternative adaptive strategies that incorporated changes in the use of different technologies and tool types in different time periods and in different ecological settings. These shifts would explain the evidence for contemporaneous use of various unifacial tools and projectile point styles and hafting techniques (i.e., Fishtail and Paiján). In short, the available evidence suggests that a general hunting and gathering economic base exploiting a wide variety of habitats was present in the study area from the inception of humans to the terminal Preceramic period around 5,000 years ago and that this base set the foundation for later developments in the early to middle Holocene period.

CHAPTER FIVE

Las Pircas Phase (9800–7800 BP)

Jack Rossen

The Las Pircas phase was a florescent period of Preceramic culture in the Zaña and Nanchoc valleys. Throughout the lower and middle Zaña Valley, the hunter-gatherer lifeway of the El Palto phase continued, but in a portion of the middle and upper valley, a new lifeway emerged in the steep forested lateral quebradas, an area we refer to as the Nanchoc pocket or basin (Dillehay and Netherly 1983; Dillehay et al. 1989). Despite showing evidence of only sporadic and apparently unsystematic outside contacts, the Las Pircas phase in this area was a time of significant sociocultural change, including the adoption of a wider inventory of cultigens (Dillehay et al. 2007; Rossen 1991; Rossen et al. 1996). It was also a time of probable ritual cannibalism and garden magic, manifested by careful cutting and placement in pits of adult male bones and by the presence of quartz crystals placed in furrows. This was evidently related to the broad cultural changes brought about by the shift to a house gardening economy (Rossen and Dillehay 2001a,b). Principal changes of this period occurred in and around the houses and not in any public or communal setting (Dillehay et al. 1999), which took place late in the period and during the following Tierra Blanca phase.

The evidence of earlier pre-Las Pircas populations in the upper middle Zaña and Nanchoc valleys was discussed in the last chapter. Specifically, in the lower to middle portions of these two valleys, many El Palto phase sites are present along river terrace remnants at confluences where late Pleistocene geological formations remain intact (Fig 5.1). Most sites are heavily deflated, with small circular or elliptical stone hut foundations and apparent hearth features. They primarily contain heavily desert varnished, crude unifacial lithic tool assemblages similar to the Siches and Amotape lithic assemblages found in Talara in extreme northern Peru (Richardson 1969, 1978). Heavy wind deflation and the absence of organic materials

Figure 5.1. Location of Las Pircas sites in the study area.

usually hamper investigation of these sites (Rossen et al. 1996). Forty-eight Las Pircas phase sites have been found and nearly all of these are in the Nanchoc basin. Following the Las Pircas phase, the subsequent Tierra Blanca phase is marked by the development of public places, as represented by expansion of the mounds at the Cementerio de Nanchoc site (CA-09–04), the augmentation of the cultivated plant inventory, and the appearance of irrigation canals, but by that time, the fine lithics and the careful

Figure 5.2. Surface of a Las Pircas site (CA-09–27) in the upper part of Q. Las Pircas.

treatment of the dead during the Las Pircas phase had devolved (see Chapters 6 and 8).

Individual sites of the Las Pircas phase in the Nanchoc pocket are small, almost always less than 1,000 m^2 in size. They usually contain one or two small round *quincha* (cane walled) huts defined by a stone-lined foundation, a small stone above-ground storage unit, and a furrowed house garden zone, all overlain by dense but shallow sheet middens 20 to 60 cm in depth (Fig. 5.2). An exception is CA-09–28, a site dominated by cannibalized remains within its midden (Rossen 1991). Sites are heavily clustered in certain quebradas, perched on narrow alluvial fan remnants in heavily dissected terrain (Fig. 5.3; Dillehay et al. 1989). For instance, as many as twenty-five contemporaneous households were located in the upper portions of two km long quebradas like the Q. de Las Pircas, Q. Tierra Blanca, and Q. Sin Nombre (QSN), while quebradas like Q. El Palto and several other small alluvial fans are totally devoid of sites of this period (Rossen 1991). The settlement pattern could thus be described as "pseudo-dense," in that dense clusters of household sites were not forced by the absence of available land or resources, but appear to have been a social choice (*sensu* Bronson 1977).

The Las Pircas phase is a time period during which the Nanchoc area may be viewed as a regional locus of cultural development. This is not to say that plant cultivation began here and not in other places throughout the Andes and beyond (Dillehay et al. 2007; Rossen et al. 1996). It is

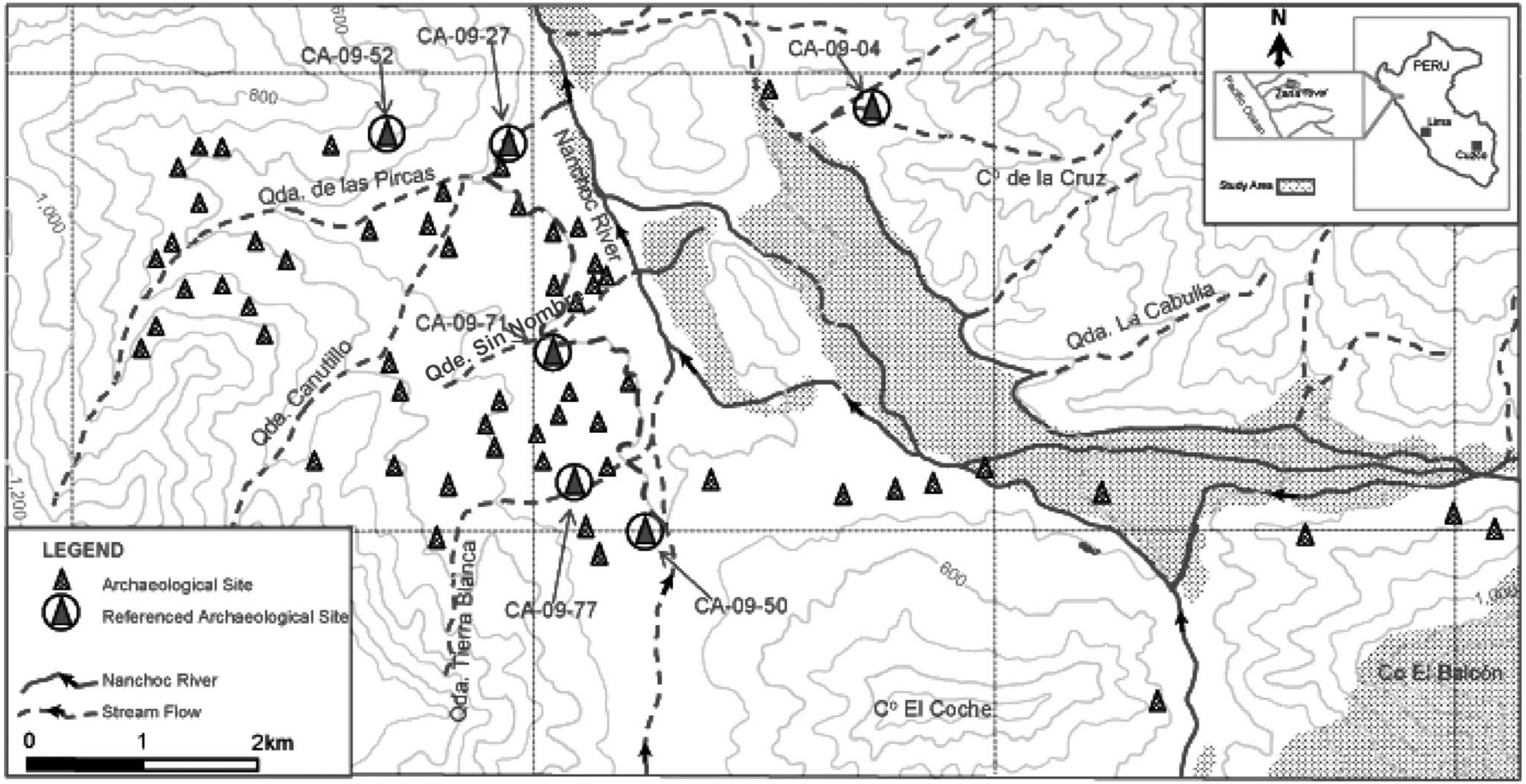


Figure 5.3. Map showing location of Las Pircas and Tierra Blanca phase sites in various quebradas of the Nanchoc basin.

instead likely that similar and different manifestations of plant cultivation and ritualization occurred from ~10000 to 8000 BP throughout the Andes, based on similar case studies elsewhere in Peru and in Ecuador and Colombia (Aldenderfer 1998; Correal 1989; Stothert 1985, 1988). In the Las Pircas case, appreciating the achievements of this time period depends on understanding both the advantages and limitations of the dry and humid forests in the Nanchoc basin, the selectivity of outside communication, the combination of plants chosen for cultivation, the fine unifacial lithic industry (the Nanchoc Lithic Tradition [NLT]), and the effects of the ritual process that occurred. Ultimately the Las Pircas people were victims of their own success. Rising populations moved gradually down the quebradas toward the main valley floor where field agriculture and public ritual sites were possible during the Tierra Blanca phase (Dillehay et al. 1989). The Las Pircas phase provides a glimpse of the local environmental, social, and ritual forces surrounding the beginnings of economic intensification in the Andes.

ENVIRONMENTAL SETTING

It was previously believed that the Las Pircas period was a relatively warmer and drier time in the forests than today (Damuth and Fairbridge 1970; Hansen et al. 1984; Piperno 1990; Wright et al. 1989). There is now paleoenvironmental evidence that contradicts this view and suggests that the Las Pircas phase was relatively warm and humid (see Chapter 3). The lateral quebradas of Nanchoc are today covered by a seasonally dry forest. In 1868, the area was solidly tropical forest, and trees in the Nanchoc basin were cut for export as the area was converted to hacienda agriculture (Raimondi 1940 [1874]: 262–263). The gradual decimation of this forest was described throughout the twentieth century (Koepcke 1954; Koepcke and Koepcke 1958, Weberbauer 1945: 27, 47, 444–446). The Nanchoc basin contains remnant fauna including boa constrictors, racer snakes, and tropical insects (Cadle 1991; Carpenter 1985). Present-day humid montane forest pockets of the upper Zaña and Jequetepeque valleys were then a continuous band that crossed several northern Peruvian valleys (Raimondi 1940 [1874]: 262–263; Simpson 1975a,b; Vuilleumier 1971). Faunal remains from the Las Pircas phase middens include *tinamou*, boa-like snakes, and *jaguarundi*, species suggesting that tropical conditions were present on the western slopes during this time. The overall conclusion is that the Nanchoc area was a pocket of humid montane to seasonally dry forest that remained

warm and humid despite a broader drying trend that affected northern Peru and the remainder of the Zaña Valley.

During the terminal Preceramic period, a continuous downward thrust of settlement pattern is evident in the Zaña Valley. That is, both Las Pircas and Tierra Blanca households moved gradually downward within the quebradas over a few thousand years until the quebradas of the upper middle valley were largely abandoned and the main middle valley floor was occupied during the Initial Period (~5000–3500 BP; Dillehay et al. 1989). The initial positioning of settlements in quebradas and the eventual gradual downward movement of settlements toward the main valley floor can be understood in terms of the changing advantages and disadvantages of life in the smaller and higher lateral valleys. During the Las Pircas phase, the valley floor was heavily vegetated. Mosquito-driven diseases like leichmaniasis were prevalent in the area until the early twentieth century (e.g., Gade 1979) and may have existed in the Preceramic period as well. The dual problems of the labor required to clear the valley floor and disease thus possibly made the upper valley quebradas in areas like the Nanchoc basin more attractive for settlement. The quebradas of the upper middle valley and Nanchoc area also contain easy access to multiple ecological zones and pathways up and down the valley. Further, the soils of small dissected alluvial flats and adjacent running water in these areas were suitable for small house gardens but were too limited in size for larger multifamily farming. Following the Las Pircas phase, the pressures of a larger population, the need for larger agricultural plots, and the movement of ritual out of households and into public settings eventually overrode the negative elements of labor and perhaps disease for clearing and inhabiting the lower quebradas during the following Tierra Blanca phase and later the main valley floor itself. The Las Pircas phase thus appears to highlight a global archaeological pattern of the development of gardening along small upland streams, setting the stage for later cultural intensification in river valleys (Bellwood 2004; Denham and White 2007).

ARCHITECTURE AND FEATURES

One or two households lived and gardened at each Las Pircas site. Building materials used included cane, mud daub, dried-mud brick, and stone. The Las Pircas people slept and performed some activities within small elliptical *quincha* huts (Figs. 5.4–5.5). The best excavated example is at site CA-09–27. This hut measures 2.3 by 2 m in size, with a hard-packed dirt floor

Figure 5.4. Schematic drawing of Las Pircas houses and gardens.

4 to 6 cm thick (Fig. 5.6). Sixteen postholes were present, perfectly circular and relatively uniform in size and depth (9 to 12 cm in diameter, 16 to 21 cm in depth). The hut contained a small central hearth or brazier with a burned bone concentration. The structure was mud daubed and built around two small bedrock outcrops that apparently framed an entranceway (Fig. 5.4). At least two hand-formed dried-mud bricks were incorporated with uncut field stones to form the hut foundation (see Engel 1970 for a coastal example).

Ethnographic comparisons provide suggestive evidence for understanding the Las Pircas phase constructions. There were several building material options, and it appears the Las Pircas people used some unbaked mud brick as foundations for *quincha* cane and mud-daubed huts. The use of dried mud brick as a house base is more typical of the humid forests of Amazonia (Brown 1985) and does not occur today in the Nanchoc area. Mud-dried brick house bases similar to the Las Pircas structures have been observed along the Ucuyali River in the Amazonian Montana (Concepción Gonzalez del Río y Gil, personal communication 1988).

Quincha dwellings, both with and without mud daubing, are still commonly built and occupied in the Nanchoc region (Fig. 5.7). Modern *quincha* houses are rectangular instead of elliptical with entrances to the northeast and are much larger than their ancient counterparts (averaging 16 m^2). Both ancient and modern *quincha* huts, however, use rocks and boulder outcrops to support walls and contain unaligned post holes as a result of remodeling

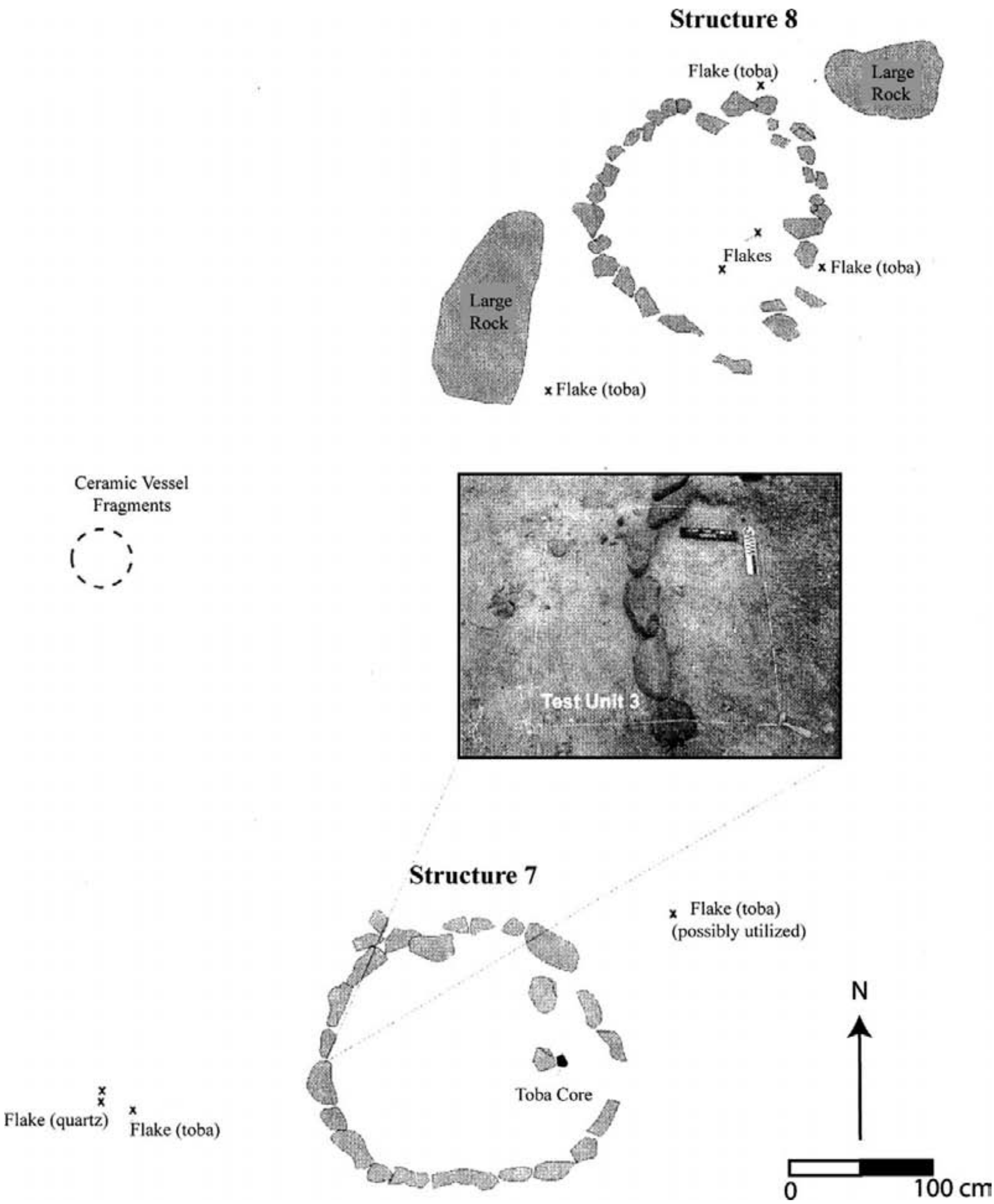


Figure 5.5. View of excavated hut foundations of a Las Pircas house at JE-971.

and rebuilding. The hard-packed dirt floors of both are of similar thickness, with embedded small artifacts, charcoal, bone, shell fragments, and other debris. In the modern *quincha* houses, artifacts tended to be lost in the intersection of wall and floor, exactly where materials like beads and a manioc peel were found at site CA-09–27 (Rossen 1991).

Small above-ground stone structures provided storage for plant foods. The best example is from site CA-09–27; it measures 1.2 by 1 m in size.

Figure 5.6. Plan view and photograph of excavated hut floor and foundation at CA-09–27.

Figure 5.7. Modern-day *quincha* hut in the Zaña Valley.

Unmodified naturally fractured granite and diorite stones fully enclosed and capped the structure (Fig. 5.8). As with the *quincha* hut, a few hand-made dried-mud bricks were incorporated into the base and wall of the structure.

Last, the basal layer of the two earth-filled, stone-faced mounds at the Cementerio de Nanchoc site were first constructed during the latter part

Figure 5.8. Stone-storage unit at CA-09–27 of the Las Pircas phase.

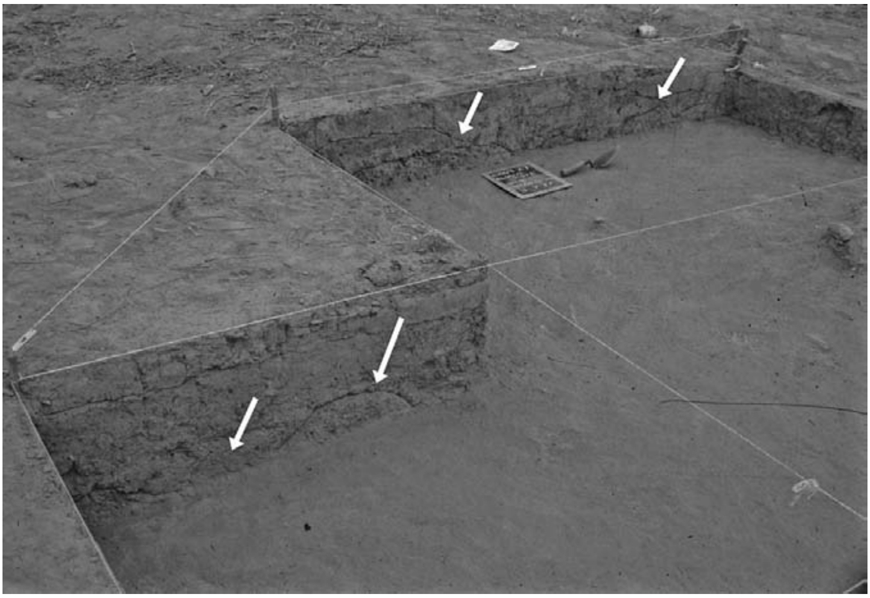


Figure 5.9. Superimposed garden furrows (arrows) at site CA-09–27.

of this phase, although their function and size at this time are not well understood (see Chapters 6 and 7).

HUMAN REMAINS

Human remains at the Las Pircas sites were carefully cut and placed in piles within pits. Only adult male remains have been recovered. Cut bone piles primarily consist of long bones sliced to 1 to 12 cm lengths (site CA-09–28). In one case a skull was cut radially, and in another case an entire elder male was cut into 2.5 to 5.0 cm lengths and placed in a 30 cm diameter pit (site CA-09–52). One intact adult male was recovered lying on his back with his legs flexed (site CA-09–28). The case for ritual cannibalism and its implications are discussed below and in Chapter 8.

HOUSE GARDENS

House gardens appear in Las Pircas phase sites as zones where the buried strata are furrowed, with the furrows oriented perpendicular to the downslope direction. Some garden areas contain multiple superimposed layers of furrows (Fig. 5.9). A detailed spatial analysis of artifacts shows that furrowed areas contain very few unclustered lithics. Large blocky lithic tools interpreted as sodbusters are exclusively located in these furrowed zones.

Quartz crystals, ammonite fossils, and worn stingray spines recovered from these zones are interpreted as representing garden magic (discussed later in this chapter).

Garden plants documented from macro-remains include squash (*Cucurbita moschata*), peanut (*Arachis*), manioc (*Manihot* sp.), and a quinoa-like chenopod (*Chenopodium*, cf. *quinua*). In addition, a recent study of starch grains recovered from human teeth from Las Pircas huts also documented bean (*Phaseolus* sp.), other unidentified legumes, *pacay* (*Inga* sp.) and globular and bell-shaped starch grains along with the aforementioned peanut and squash (Piperno and Dillehay 2008). These plants are discussed in detail in Chapter 9. The combination of plants of coastal, mid-slope, distant highland, and long-distance (e.g., squash from Colombia, peanut possibly from Bolivia) origin are notable, suggesting that plants were initially carried or exchanged to the Las Pircas phase sites to be gardened.

OTHER SUBSISTENCE

In addition to house gardening, the Las Pircas people engaged in a broad-spectrum hunting and gathering economy (see Chapters 9 and 10). White-tailed (*Odocoileus* sp. v. *peruvinus*) and brocket deer (*Mazama* sp.) were hunted, although no projectile points have been recovered from any Las Pircas phase sites. Lizards and snakes, including iguana (*Iguanidae*), smaller lizards (*Callopistes flavipunctatus*, *Dicrodon guttulatum*), and racers (*Spilotes pullatus*) were trapped or snared. Crayfish were taken from nearby creek beds.

At least ten species of marine shell are present in these sites, including four species that are no longer present at the mouth of the Zaña River 80 km west of the Las Pircas quebrada in the Nanchoc basin. These species are today found between 30 and 650 km to the south. The low frequencies of recovered marine shell fragments (133 found on six sites) represent a minute assemblage compared to the hundreds of thousands of shells recovered at coastal and lower valley sites. Marine shell thus represents only sporadic contact with the littoral zone. Seafood was at most a rare and special addition to the Las Pircas diet, and it is more likely that shell represents bead making at these sites.

Land snails are abundant in Las Pircas phase sites in both the Q. de Las Pircas and in the lower valley in the Q. del Batán and Q. Talambo area (Stackelbeck 2008: 344–360). In the Q. Las Pircas, four species were recovered (*Scutalus* sp., *Drymaeus* sp., *Drymaeus vexillum*, *Bostrix elegantus*). The lower valley collections also include the megasnail (*Megabulimus* sp.). Studies of the size and distribution of the archaeological specimens and

comparison with living colonies from the other side of the Nanchoc River provide convincing evidence that snails were a significant dietary component (Rossen 1991: 546–558). Only unusually large specimens were archaeologically recovered and snails were clustered in features and spatially correlated with other food remains. Snails were probably steamed, leaving their intact unburned shells to be discarded and recovered from the middens (Diesler 1986). Based on the consistent high frequencies of snails in the lower valley sites of Q. Talambo and Q. del Batán, snail consumption appears to have been a valleywide phenomenon (Stackelbeck 2008). Evidence for large-scale consumption of land snails has been recovered at other Preceramic sites of northern Peru, particularly in the Q. Santa María near Trujillo (Briceño 1999, Gálvez et al. 1994). In later ceramic times, snail collecting is depicted on Moche vessels (Donnan and McLelland 1999: Figures 4.86, 6.48, and 6.49; Gálvez et al. 1994: Fig. 5.2), and ethnographic descriptions are also numerous (Gálvez et al. 1994). Wild plant collecting by Las Pircas phase people in the Nanchoc basin is represented by the presence of ancient wild plum (*Bunchosia* sp.) and other unidentified Solanaceous and cactus fleshy fruits.

Another line of evidence of the Las Pircas diet is the teeth associated with human remains. Tooth wear is exaggerated and advanced, not from abrasion such as in the cases of shellfish eaters who consume quantities of sand, but from mechanical stress associated with chewing tough plant material. It is also noteworthy that no signs of disease were noted in the skeletal remains, leading to a conclusion that an adequate diet existed, free from obvious vitamin or mineral deficiencies (Guillen 1988).

THE NANCHOC LITHIC TRADITION

Given the marked change in lithics from the bifacial assemblages of the El Palto phase to the unifacial ones of the Las Pircas and Tierra Blanca phase and the dominance of unifaces after ca. 9500 BP, a relatively detailed description of the latter is warranted. The Nanchoc Lithic Tradition (NLT), the unifacial lithics of the Las Pircas phase, is a varied industry heavily oriented to plant cutting and slicing and woodworking activities (Rossen 1998). Unifacial lithics have been generally misunderstood by archaeologists, who have usually characterized these industries as amorphous, unsystematic, and/or highly expedient (Henry and Odell 1989). In contrast, unifacial industries may be appreciated in terms of their widespread presence throughout the Americas and their dynamism and relationships to plant-dominated economies and intensification (Dillehay et al 2003;

Pearsall 1992). Underlying the deceptive simplicity of the reductive sequence and tool forms, perhaps reinforced by the absence of bifaces, is a complex and multidimensional lithic industry. Consideration of the NLT emphasized five aspects of analysis: stage of reduction sequence, formal tool typology, edge angles, raw material type, and use-wear analysis (see Chapter 11; Rossen 1998; Rossen and Dillehay 2001a).

The NLT displays an attenuated reduction sequence of three stages. This contrasts with bifacial lithic industries that contain six to twelve stages of reduction. Stage 1 is cores and rarely, core tools. Stage 2 is unmodified secondary flakes that were sometimes utilized. Stage 3 is trimmed and shaped secondary flakes. Stage 3 includes a proliferated set of formal tool types produced by nonmarginal trimming (Speth 1972). Even the debitage of the NLT is distinctive, particularly for the preponderance of flakes with greater flake width than flake length. Las Pircas phase sites can thus be distinguished from other Preceramic phase sites by their surface flake scatter.

The formal tool typology features sixteen formal types based on shape, thickness, and size (Fig. 5.10). There are three sizes each of quadrilateral, semilunar, and triangular unifacial tools. Distinctive pentagonal and long-handled, short use-edge tools are common. A few waisted hoes also appear at several Las Pircas sites.

Edge angles were analyzed in coordination with tool angles to understand the combination attribute of tool edge type (TET). When the edge angle is greater than the tool angle, there is a heavier edge more suitable to woodworking, while the opposite, an edge angle smaller than a tool angle, reflects a fine edge probably used for cutting and slicing. Several formal types of the NLT display clearly defined edge angle and TET modes, enabling the industry to be understood in terms of the dominance of plant cutting, slicing, and heavier woodworking activities (Rossen 1998).

Taking the lithic analysis further was a detailed microscopic analysis of use-wear, polish, and residues (Dillehay and Rossen 2001a). In conjunction with spatial analysis of lithic tool location within the sites, the microscopic analyses confirmed the dominance of plant-related activities through a preponderance of bright plant sheen on lithic tool edges. These analyses also determined that semilunar tools were often used for cutting the human bones at site CA-09–28 based on the presence of dull greasy polish on tool edges. Many lithic tools also display plant fibers along their edges.

Thirty-three raw lithic material types are found at Las Pircas phase sites. The dominating materials are black basalt (46.5%), cream or off-white

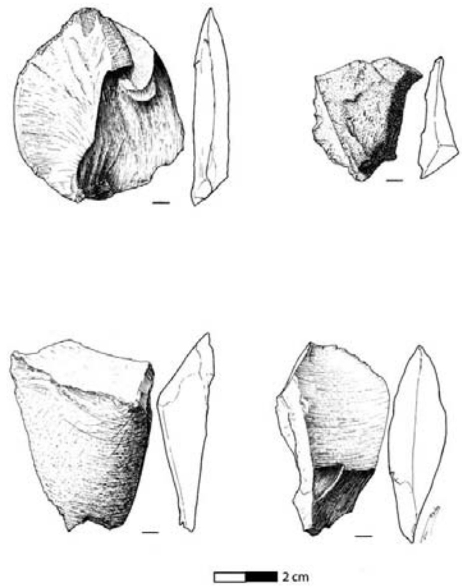


Figure 5.10. Various unifacial tools of the Las Pircas phase.

diorite (15.7%), gray, veined mylonite (12.9%), off-white limestone (7.8%), gray andesite (7.5%), and banded rhyolite (6.5%). These are all locally available in the creek beds adjacent to the household sites. There are also twenty types of silexes, crystalline quartzes, and jaspers that are considered exotic to the region. These are finer and more attractive materials than the locally available materials, particularly the crystalline quartz and the variety of silexes (banded, cream, coffee, black with red streaks, gray with red streaks, and gray banded). Although these exotic types comprise nearly two-thirds of all raw material types, they represent only 1 percent of all lithics, a statistic that reinforces the localized nature of the culture and the sporadic and unsystematic nature of outside contacts (Rossen 1998).

Raw lithic materials appear to correlate with different activities and site functions. For example, andesite never appears as more than 6.7% of a lithic assemblage at Las Pircas household sites, but at site CA-09–28 with its cut human remains, 32.8% of all tools were made of andesite.

One locally available lithic raw material worthy of mention is dark green copper ore. It appears as roughly 0.4% of all lithics (n = 126 in the Quebrada de Las Pircas sites). More than most raw lithic material, copper ore at Las Pircas sites was heat treated to produce a finer grain for flaking. It is unclear whether this is unrelated to or a fortuitous or systematic precursor to the smelting of copper. The first small smelted copper objects appear locally during the subsequent Tierra Blanca phase.

In summary, the NLT is the defining assemblage of the Las Pircas phase. The deceptive apparent simplicity of this unifacial industry tends to obscure its underlying complexity. In particular, there are more formal tools and tool types than are usually credited to unifacial industries. Studies of edge angles, tool angles, and combination attributes like tool edge types were able to delineate the uses of many tool types, especially in combination with microscopic studies of use-wear, polish, and residues. The raw materials of the industry define the basic nature of Las Pircas culture as localized with sporadic and unsystematic outside contacts.

The NLT displays relative morphological stability and consistency. The percentages of materials in each stage of the reduction sequence, formal tool types, and attributes are consistent at the various sites. Scholars have often portrayed unifacial lithic industries as amorphous, irregular, and unsystematic, and this may be true in some cases. The NLT, however, is an example of a lithic industry where edge angles conform closely to formal types and where the repetitive forms of trimmed flake tools are notable. Also, while most unifacial industries are classified as extremely expedient and the NLT can be generally classified as expedient, it contains elements of both expedient and curated industries (Binford 1977, 1979). Some relatively well-made, heavily used tool types are present, such as the semilunar and pentagonal forms. Many cores are exhausted, and cores have multiple recurring forms instead of being amorphous, all traits of less expedient industries.

One paradox of the NLT is the apparent combination of highly exhausted cores and material conservation with local abundance of raw material. One possible explanation is that the present-day abundance of basalt cobbles in the steep, dry creek beds adjacent to sites presents a false illusion of abundance. The heavy vegetation and flowing water of Las Pircas times may have produced a lower real availability. It is also possible that ideals and ethics of raw material use and conservation may sometimes be unrelated to abundance and availability (Rossen 1998).

Above all, the NLT is an industry based on local materials. Exotic materials are a very low percentage (1.1%) of the industry and this percentage is consistent across different sites and stages of reduction. Exotic materials were treated similarly to local materials in terms of reduction sequence and are distributed evenly across sites. Some exotic materials may exhibit the pattern of "embedded procurement" (Bamforth 1986; Binford 1979). That is, some exotic materials may have been procured by sending out individuals or small groups to collect, or materials were procured incidentally or opportunistically in the course of other travel-related procurement. This is opposed to receiving exotic goods in trade or exchange, where the exotic material is expected to be more reduced at sites and thus more valuable than local materials. From the perspective of the NLT, the Las Pircas people cannot be viewed as cultural mediators, large-scale exchangers, or seasonally mobile or transhumant people.

Across South and Central America, unifacial lithic industries are generally associated with forested environments and plant-oriented economies. Some are associated with at least incipient levels of plant cultivation

(Correal 1989; deFrance et al. 2001; Linares and Ranere 1980; Malpass 1983; Porras 1988; Richardson 1969; Stothert 1974, 1988; Temme 1982). Unifacial industries like the NLT may thus be considered an archaeological indicator of intensification, or at least a shift toward different kinds of human-plant relationships that led to cultivation. In the Nanchoc case, it is the presence of relatively well-made formal tool types within the usually expedient industry and the microscopic use-wear analysis that connected many of these tool types to plant processing that led to this conclusion (Rossen and Dillehay 2001a; Rossen 1991).

During the following Tierra Blanca phase, unifacial lithics are still present, but formal tool types disappear and lithics in general become less systematic and more amorphous.

OTHER INDUSTRIES

Ground stone is numerous at Las Pircas phase sites, with three block excavated sites (CA-09–27, CA-09–28, and CA-09–52) producing 116 specimens. All but six were recovered from subsurface excavations, suggesting the low visibility of this industry during site survey. The high frequency of grinding slabs and manos is in strong contrast with earlier Paiján sites, which contain very few of these materials. Ground stone implements primarily represent the processing of seeds into flour, and an overall emphasis on plants in the economy. Slabs and hand grinders are frequent inside and near huts, and they were also used as anvils in cutting human bone. Occasional red and yellow stained specimens were probably used for grinding inorganic pigments, possibly for body painting. Smaller ground stone objects used for rubbing, polishing, abrading, and spinning (spindle whorls) have also been recovered. While some contemporary Brazilian traditions contain substantial amounts of ground stone (Schmitz 1989), it is rare in north and central Andean traditions such as Siches at Talara in far northern coastal Peru (Richardson 1969), Mongoncillo in the Casma Valley of central Peru (Malpass 1983), and the earlier portion of the Las Vegas sequence of coastal Ecuador (Stothert 1988). This suggests that in the Nanchoc area, a plant-oriented economy and cultivation experiments were well developed.

Small chunks and worn and smoothed, cone-shaped fragments of powdery calcite or lime are scattered throughout the Las Pircas middens. Calcite became important later for chewing with coca leaves, and calcite precipitation was a featured activity at public sites of the subsequent Tierra Blanca

phase (Dillehay et al. 2010). During the Las Pircas phase, it appears that small amounts of calcite were precipitated at household sites for unknown purposes, since coca did not appear until Tierra Blanca times.

Minor industries of worked bone, antler, and shell are evident in the Las Pircas collections. There are very low frequencies of bone and shell beads, along with seashells with cut squares. Deer tine tips were cut and shaped, perhaps to make flakers.

RITUALIZATION

Ritualization is a term that describes a process of the development of ritual in response to culture change and a sweeping reorganization of lifeways, particularly when spiritual danger is perceived (Coursey 1976; McGhee 1997). The Las Pircas people were developing new, closer relationships to the plants of their house gardens, and thus the onset of probable ritual practices as attempts to mitigate and control supernatural powers and spirits should be expected.

The bones of adult males were carefully and cleanly cut or cut and snapped and placed in pits. The ends of some long bones were smashed, apparently to remove marrow (Fig. 5.11). The absence of splintering along the cut faces indicates that bones were cut fresh rather than being dried and cut in conjunction with the practice of secondary burial (Rossen and Dillehay 2001b; cf. Santoro et al. 2005; see Chapter 8).

Contextual consideration of the disarticulated and fragmented human bones underscores their separation from daily domestic activities. Most cut bones and bone piles occur at site CA-09–28, a site that contains no huts or mud daub. Human remains were thus not treated like faunal remains, in that there is no admixture with midden materials.

In considering the nature and context of disarticulated and cut human remains, Lumbreras (1989) compiled and discussed numerous archaeological case studies throughout the Andes, beginning with the late Preceramic period. Lumbreras believes that widespread evidence of cannibalism has been ignored or mentioned only as an aside (Lumbreras 1989: 206–216). These case studies include the coastal Preceramic sites of Asia, Aspero, Los Gavilanes (Bonavia 1982b; Engel 1963; Feldman 1977) and the Preceramic southern highland site of Pachamachay (Rick 1980). Similar evidence of cannibalism has long been debated in the American Southwest, but these cases have been connected to cultural devolution and social conflict instead of ritual and intensification (Turner and Turner 1998; White 1992).

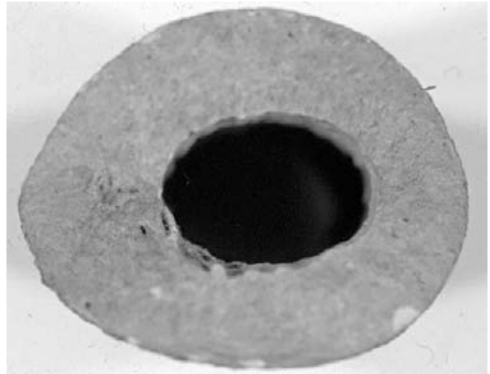


Figure 5.11. Cut end of human long-bone from site CA-09–28.

Elsewhere in tropical America, evidence of Preceramic disarticulated human remains has been documented. In Colombia, the Aguazuque site contained substantial cut and placed human bone, including crania carved with curvilinear and spiral designs dated to 4400 BP. Other examples where cut human bones have been associated with cannibalism are Cerro Mangote and Aguadulce Shelter, Panama, both dating to 7800–6600 BP (Correal 1989: 146–154, 255–256; McGimsey and Collins 1986–1987; Ranere and Greenfield 1981).

Small exotic objects including quartz crystals, ammonite fossils, a single *jaguarundi* bone, and grooved and worn stingray spines are scattered throughout Las Pircas phase domestic sites, virtually always in the undulating strata areas interpreted as furrowed garden plots. In eastern Peru, peoples such as the Jivaro place small distinctive objects in their plots as garden magic. In the Jivaro case, garden magic serves multiple purposes: to ensure fertility, to protect the gardeners against the plant spirits, and to protect the garden from theft. Women find, own, and place the objects in gardens, in the reported belief that intruders will be eaten if they steal from the plots (Brown 1985: 125–130). In the Las Pircas phase case, it is tempting to speculate on a male/female ritual dichotomy involving cannibalism, in which actual male cannibalism counterpoints against a symbolic female version that was embodied in garden magic (Rossen and Dillehay 2001a,b).

The exact nature of the freshly cut and placed human bones and the exotic objects placed in gardens may be elusive. Ethnographic comparisons across thousands of years provide only suggestive evidence. They can be understood in general terms as part of the ideological process of ritualization. It is a process that begins with the initial colonization of the quebradas and alluvial fans above the valley floor when people settle into a new environment and begin to manipulate new resources. Defining sacred space on the landscape and controlling and channeling the spiritual power of natural components must have been as important as the development of locally appropriate technologies and new resources.

SUMMARY

The Las Pircas phase was a Preceramic western slopes dry forest culture, located primarily in the Nanchoc basin. Preceded by only small populations of mobile hunters and gatherers and late Paiján foragers and gardeners, the Las Pircas people settled in the lateral quebradas above the main valley floors and in higher elevated zones that were semi-forested or forested. One or two small households per site tended small gardens, trapped and snared small animals, and occasionally hunted deer. Households in Nanchoc adopted cultivated plants from both local and distant environments, melding them into a suite of plants probably unique to the upper valley locale. Neighboring households were only a few hundred meters away, across the creek on small flat alluvial fan remnants. Despite the concentrations of household sites in some quebradas, other quebradas were not settled, leading to a characterization of the settlement pattern as dispersed or "pseudo-dense." That is, there is no evidence that the Las Pircas people were under population pressure when they adopted cultivated plants. In contrast, it appears that the Las Pircas people were a relatively small population living in a stable, resource-rich forest setting with access to a variety of ecological zones. Skeletal remains indicate a healthy population without endemic problems. The one exception was tooth wear and loss associated with chewing tough fibrous plant foods.

There was an innovative and experimental temperament to the Las Pircas people. They developed a series of new technologies. In particular, their unifacial lithics represent a complex and varied tool kit with formal types focused on the harvesting and processing of plants but also used for butchering, processing animal hides, and ritual activities. Ground stone slabs, bowls, and manos for processing seeds into flour were another prominent new technology. There was also the first use of calcite, which becomes important later during the Tierra Blanca phase in the development of public places and the use of coca leaf. Associated with the production of calcite were the first layers of the two mounds at the Cementerio de Nanchoc CA-09-04 site across the valley.

Las Pircas life was intensely ritualistic, and ethnographic analogies suggest complementary and opposing ritual spheres. Careful cutting and placing of adult male bones in piles within pits, probably associated with ritual cannibalism, represents the male ritual sphere. The placement of crystals and fossils in furrowed garden areas, strongly suggestive of garden magic, possibly represents the female ritual sphere. There are many case studies that discuss the spiritual dangers of house gardening, as people began to

interact closely with plants and their spirits, moving them from the forests to their settlements. The ethnographic case study that is most pertinent is the Jivaro, some of whose sites are laid out on alluvial fans with house, storage unit, and gardens in a remarkably similar way to Las Pircas sites (Brown 1985).

The reverse side of the Las Pircas culture was its localization and isolation. According to materials found in household sites, outside contacts were sporadic and unsystematic. Only a very small amount of coastal shell was present, and exotic silexes and crystalline quartz, much finer and more beautiful than locally available basalt, andesite, and diorite, are barely 1 percent of lithic raw material. The distinctiveness of the unifacial lithics and their formal types from other unifacial industries in northern Peru such as Siches also suggest relative isolation.

A few comments may be made on the transition of the Las Pircas phase to the subsequent Tierra Blanca phase about 7800 BP. Tierra Blanca sites are generally situated lower but still inside the lateral quebradas. Houses expanded in size and became rectangular multi-room structures with stone foundations. House gardening expanded and added new plants such as coca and cotton, and the gardens apparently became separated from the domestic sites. Unifacial lithics were increasingly crude and amorphous, and formal types disappeared. Cutting and defleshing of human bone continued, but bone was no longer carefully cut and placed in pits. Instead, bone beds of haphazardly cut, broken, and trampled bone are found inside houses. It thus appears that the intense ritualization that characterized the Las Pircas phase and initial house gardening devolved during the Tierra Blanca phase, while populations rose and plant cultivation intensified.

CHAPTER SIX

Tierra Blanca Phase (7800–5000 BP)

Kary Stackelbeck and Tom D. Dillehay

The Las Pircas populations of the Zaña and Jequetepeque valleys began the process of experimenting with new technologies, subsistence strategies, burial practices, increased food production and water management (i.e., shallow ditch irrigation), and communal space (i.e., the initial layers of the CA-09–04 mounds). By Tierra Blanca times, people intensified their commitment to these and other developments, which led to other changes that are reflected in the material culture, construction and use of architecture, and socioeconomic organization. The social and cultural patterns that characterized the Tierra Blanca phase are summarized in this chapter.

ENVIRONMENT AND SETTLEMENT PATTERN

In the lower and middle Zaña and Jequetepeque valleys between 7,800 and 5,000 years ago, a semi-arid to seasonally dry forest setting existed with slightly increasing aridity, approximating the modern environment. In the Nanchoc area in particular, the climate during this period was warm and humid and associated with seasonally dry and humid montane forests. The appearance of canal technology by 6000 BP (Dillehay et al. 2007) in the Zaña Valley and 6800 BP in the Jequetepeque Valley (Stackelbeck 2008) may indicate attempts to harness water resources depleted as a result of increased aridity in some areas.

Tierra Blanca phase occupants committed themselves more strongly to the idea of growing much of their own food and living together in more permanent communities than did their El Palto and Las Pircas predecessors. This is evidenced, in part, by a decrease in the number of diagnostically identifiable sites (from 175 El Palto to 48 Las Pircas to 42 Tierra Blanca, respectively), increased size and internal complexity of those sites, and

intact subsurface living floors observed within multi-room domestic structures during this phase. (These numbers would likely change if we could determine how many indeterminate sites belonged to each phase. Most of the indeterminate sites are located in the lower and middle valleys, a portion of which probably represent terminal Preceramic localities dated between ~5000 and 4500 BP.) With increased sedentism through time and groups staying longer at sites, fewer sites are produced. In general, Tierra Blanca sites are located on low alluvial terraces and alluvial fans that are adjacent to river or stream drainages (Figs. 6.1 and 6.2). These sites were largely localized within the Tierra Blanca quebrada in the Nanchoc basin and consisted of a number of small, single component domestic occupations. Six of these sites were partially excavated, resulting in the recovery of substantial material data and the identification of features – many of which were associated with the occupation of domestic structures (Dillehay et al. 1999: 117).

Although fewer in number in comparison to those in the Nanchoc Valley, several Tierra Blanca phase sites were also documented in the Q. del Batán and Q. Talambo areas of the lower Jequetepeque Valley, two of which have yielded excavation data from intact, subsurface deposits that dated to ~7400 BP (JE-901) and ~5100 BP (JE-393), respectively (Stackelbeck 2008). Additional Tierra Blanca sites were also identified in these areas based on similarities in lithic technology and domestic architecture, as at site JE-890 in the upper reaches of the Q. del Batán, which is only about 15 km southwest of the Nanchoc drainage. It is possible that the environmental degradation of the middle Holocene noted above was more pronounced in the lower Jequetepeque Valley, which might explain the decreased intensity of Tierra Blanca occupation in the Q. del Batán and Q. Talambo areas. As the focus of intensive occupation shifted toward the Nanchoc area, Tierra Blanca populations evidently continued to access resources of the Batán and Talambo areas, perhaps on logistical forays.

During the middle Holocene period of the Tierra Blanca phase, the shoreline was in approximately the same location it is today. Five coastal Preceramic sites in the study area from Puerto Etén in the Lambayeque Valley to Puemape south of the Jequetepeque River are situated on desert headlands overlooking sandy and rocky beaches below. All but one of these sites is located in settings suitable for fishing and shellfish collecting. The one exception is site PV-19–61 located on the east side of the Purulén hills. This site is ~200 m long and 150 m wide. All of these sites are associated with light scatters of nondescriptive lithics (mainly small unifacial tools and waste debris made of andesite, rhyolite, quartzite, and basalt); bones of birds, sea lions, and fish; and shellfish remains (e.g., *Donax* sp). Carbonized

Figure 6.1. Location of Tierra Blanca phase sites in study area.

plant remains also were observed in these middens. These sites range in size between 150 and 400 m^2. Occasionally the remnants of stone-lined hearths were on the surface of these sites. No intact deposits were observed in the surface hearths. No windbreaks or other architectural features or ceramics are associated with these locales. Based on their stratigraphic position close to the present-day surface and embedded in Holocene shorelines, we estimate that these sites date to between 7,000 and 4,500 years ago. These

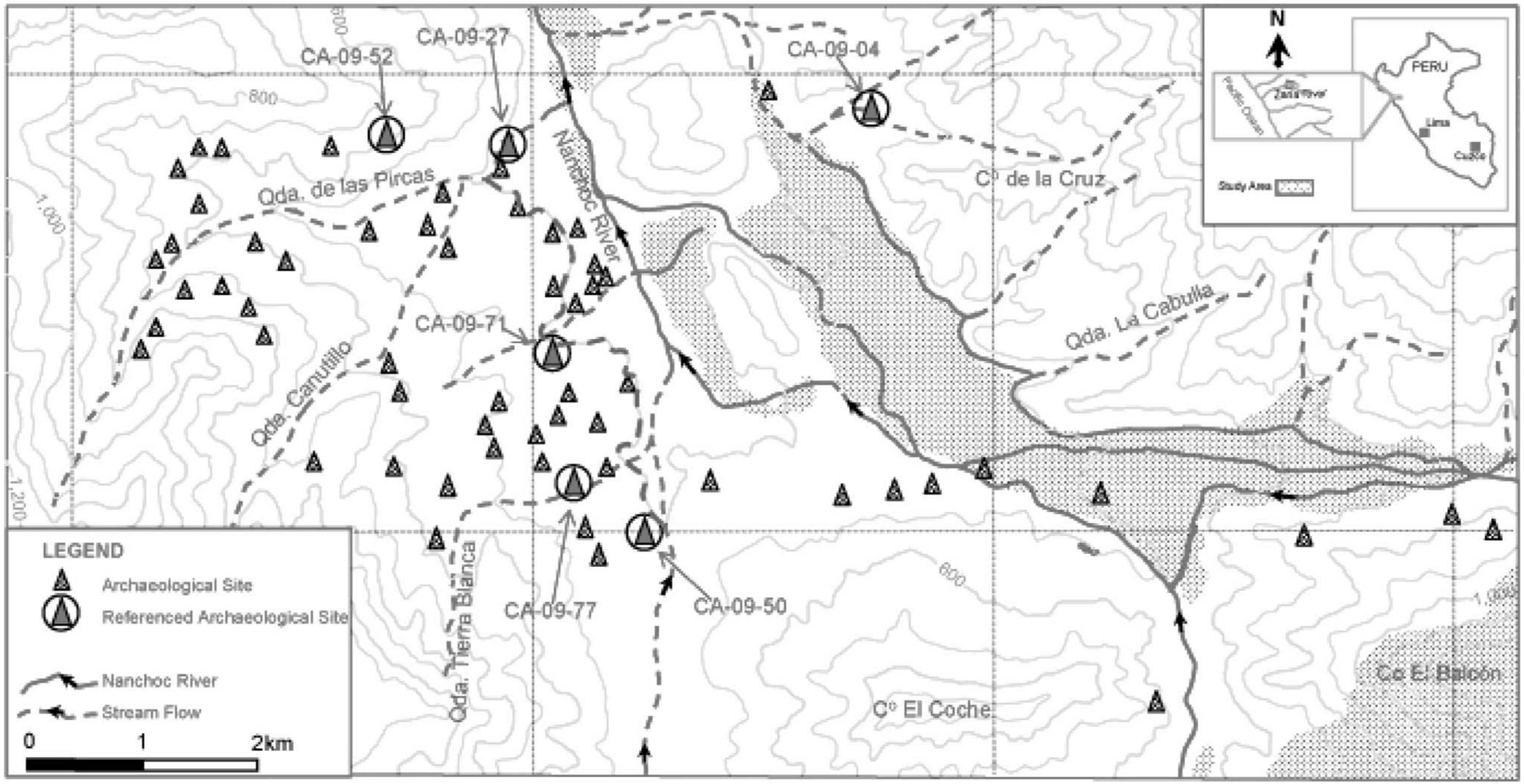


Figure 6.2. Location of Las Pircas and Tierra Blanca phase sites in the Nanchoc basin.

Figure 6.3. Dark midden at site PV-19–60 on the coast south of the Zaña Valley.

patterns and features are similar to those observed at the Preceramic sites of Huaca Prieta and Pulpar, which are located 20–30 km farther south of the study area along the littoral of the Chicama Valley.

One coastal site warrants brief mention. It is site PV-19–60, a hummocked shell midden located north of the delta of the Chamán River that measures about 2.5 m high, 25 m wide, and 40 m long (Fig. 6.3). As evidenced in a recut *huaquero* hole, the upper 1.5 m contain ceramic deposits of the Formative and Moche periods. The lower 1m of deposits exhibits Preceramic materials, including pebble unifacial tools and flakes, shell debris, and bones similar to those discussed above. We dated the lower deposit to ~7200 +/− 60 BP (Beta-39457). Test excavation revealed multiple occupational lenses and several varieties of marine shells and fish and sea lion bones, as well as a unifacial lithic industry (Dillehay et al. 1989).

Recognizing the limited Tierra Blanca presence along the littoral zone and in the Jequetepeque Valley, it is clear that the majority of sites during this phase are located in the Nanchoc area. Social factors may have played a role in drawing Tierra Blanca populations to intensify their occupation of the Nanchoc area. Although construction and communal use of the low mounds at the Cementerio de Nanchoc site (CA-09–04) began during the terminal Las Pircas phase, construction and ceremonial activities at this site intensified during the Tierra Blanca phase (see Chapter 7). Such a

commitment to communal activities evidently further strengthened a sense of community and place centered on the mounds.

The patterns of Tierra Blanca settlement in the Zaña and Jequetepeque drainages are broadly consistent with those observed for the Valdivia culture (~6000–4000 BP) of southern Ecuador (Damp 1979, 1984; Lathrap 1970; Marcos 1978; Meggers et al. 1965; Stothert 1985; Zevallos 1971). Increasing population and greater commitment to sedentism are thought to have led to the development of small communities that "consisted of groups of small, oval or circular domestic dwellings arranged in the form of a ring around an open plaza area" (Malpass and Stothert 1992 141). Valdivia is further characterized by communal ceremonialism and evidence for long-distance exchange. Limited evidence for the latter during the Tierra Blanca phase is indicated by the presence of exotic crops that were introduced from distant areas to the north and, perhaps, the south.

SUBSISTENCE PATTERNS

Tierra Blanca subsistence patterns clearly indicate concentrated efforts to exploit locally available wild resources and cultivate domesticated resources – a point that supports the above discussion of increased sedentism during this time. Some of the practices – such as gardening – that began during the Las Pircas phase expanded and intensified during Tierra Blanca times. The Las Pircas botanical assemblage included squash, peanuts, plum, manioc, a quinoa-like chenopod, fleshy Solanaceae (a family of flowering plants that includes chili peppers, tomatoes, and tobacco, among others), and cactus fruits (see Chapters 5 and 9; Dillehay et al. 1998, 2007; Rossen et al. 1996). The Tierra Blanca phase witnessed an expansion of the repertoire of domesticated plants to include coca and cotton, and intensification in the methods of producing them. This increased commitment to plant production is further evidenced by the development and use of agricultural fields and irrigation canal technology, ostensibly to harness depleting water resources in order to sustain crop production (Dillehay et al. 2007).

While Tierra Blanca subsistence patterns increasingly incorporated cultivation, some procurement of wild botanical and animal resources continued. Faunal remains from Tierra Blanca contexts indicate the exploitation of large and small mammals, land snails, and mullet and other aquatic resources, although the latter are small in quantity and possibly procured through exchange with coastal dwellers, with the exception of the Q. Talambo and Q. del Batán sites, which are closer to the coast.

TECHNOLOGY

Beyond the development of canals and agricultural fields, the shift to cultivation and intensified plant exploitation may be indicated by the stone tool technology of middle Preceramic sites in the Nanchoc, Talambo, and Batán areas. The chipped lithic assemblages among the middle Preceramic Nanchoc sites included over 50,000 collected artifacts. Only three bifaces were identified in these assemblages; these included two Ayampitin-like points made from exotic brown chert [~6950–1950 BP] – one recovered from Chical 1 (PV-19–15) in the middle Zaña Valley and the other from a site in the middle Nanchoc Valley – and one proximal fragment of a Paiján point. The remaining chipped lithics consisted of abundant debitage and expedient flake tools (i.e., retouched and utilized flakes [Fig. 6.4]), as well as flake and slab choppers. These simple tool forms comprise the Nanchoc Lithic Tradition, which consists of twenty-three formal distinctive types (Rossen 1991, 1998), many of which were likely used for woodworking and/or plant processing (Rossen and Dillehay 2001a). Lithic raw materials represented in the assemblages from these middle Preceramic sites were almost exclusively locally available (e.g., basalt, andesite, diorite), with the exception of about 1 percent nonlocal materials (e.g., silex and jasper) that likely came from highland source locations.

Chipped lithic technology of the Tierra Blanca phase is similar to that of the Las Pircas phase in that it largely consists of retouched and utilized flake tools, lacks bifacial tools, and was heavily geared toward use in plant processing. However, Tierra Blanca lithic technology is considered to be cruder and more expedient (Rossen and Dillehay 2001a: 68). The use of groundstone tools expands in the Tierra Blanca phase and was particularly important given the increased intensity of agricultural activity.

Examples of waisted unifacial hoes or adze-like tools were found at several sites in the Nanchoc basin, Q. del Batán, and Q. Talambo. These sites are located near the margins of quebradas on low, sloping terraces away from the main floor or in small, side quebradas that intersect the larger Batán and Talambo drainages. The waisted tools each display slight shouldering and thinning at the proximal end. Edge grinding is common along the proximal end, suggesting that they were hafted. The distal ends are rounded with steep bevels and appear to have been frequently resharpened. Raw materials used in manufacture include local fine-grained quartzite and basalt.

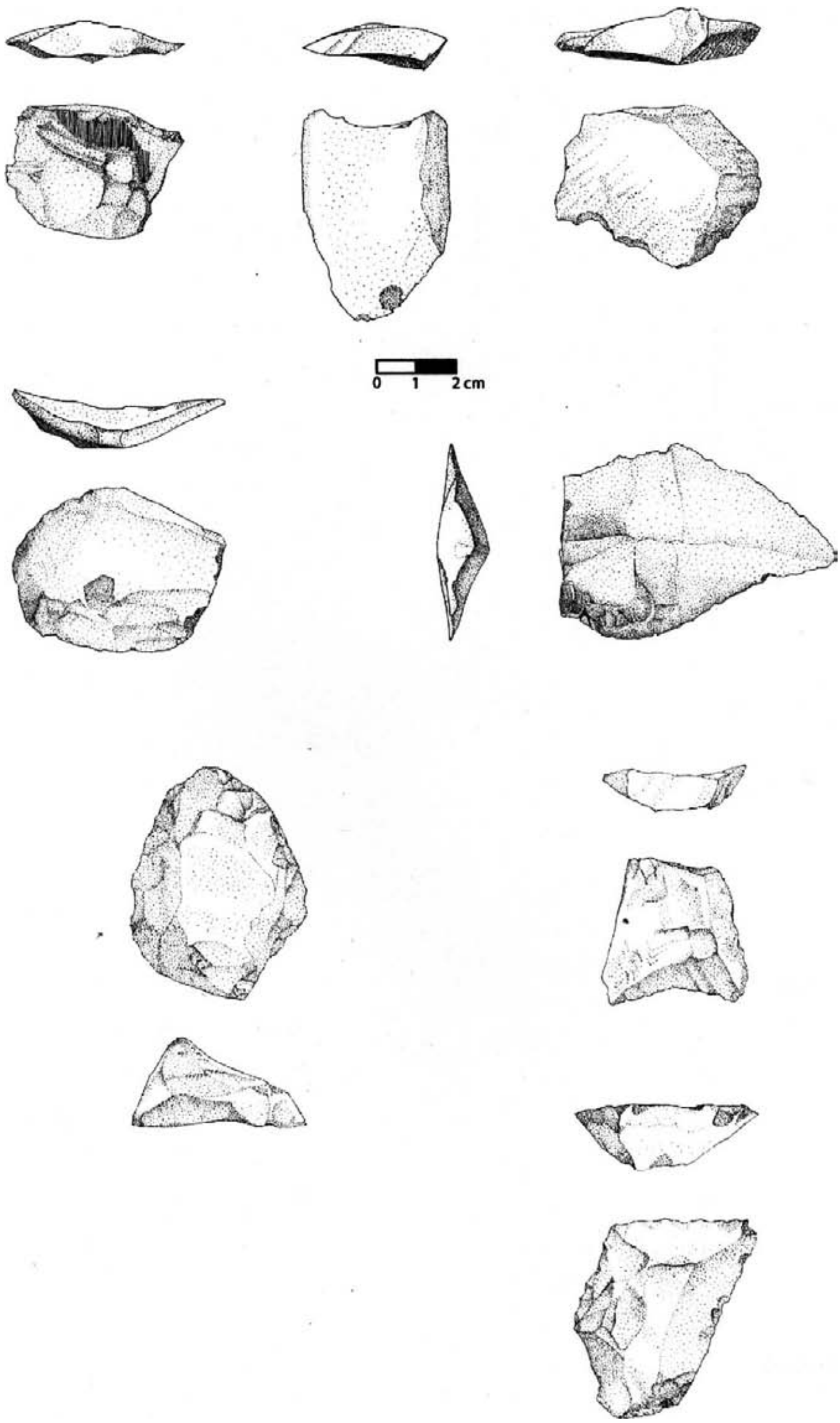


Figure 6.4. Various unifacial tools of the Tierra Blanca phase.

The lack of evidence for bifacial projectile points during the Las Pircas and Tierra Blanca phases indicates a shift in the technology used to hunt some larger mammals, such as deer. This is not surprising given our understanding of early technological developments in the Central Andes. Nonstone hunting technology – including projectiles and harpoons made of wood and bone – is known to have existed among earlier and contemporary Preceramic sites of South America (e.g., Guitarrero Cave [Lynch 1980]; Telarmachay [Lavallée 2000: 93]; and Sambaquis of the Brazilian littoral region [Prous 1991]). Projectiles made of bone or wood are also considered to have likely been part of the tool kits of the La Palestine site in Colombia (López Castaño 1995) and the Amotape complex of north coastal Peru (Richardson 1978). Other perishable technology may have included fishhooks made of bone or shell, as with those found at La Paloma on the central coast of Peru and the Camarones complex of northern Chile (Quilter 1989: 34; Schiappacasse and Niemeyer 1984). Two possible antler points were recovered from CA-09–27, a Las Pircas site (Rossen 1991). However, none of these tools were recovered from the Tierra Blanca phase sites. Today, local hunters in the project area trap and snare small fauna. The prevalence of small fauna in Las Pircas phase sites suggests this technique existed during this period. It is likely that the same pattern persisted into the Tierra Blanca phase.

DOMESTIC ARCHITECTURE

While the Las Pircas phase houses were of unsegmented, elliptical form with a small internal hearth or brazier per structure, the Tierra Blanca phase houses are semi-rectangular, multi-room, and contain storage units and two hearths or braziers. There also is a switch from *quincha* with adobe and angular rock base houses during the former phase to stone foundations during the latter (Rossen and Dillehay 2001a: 68). Typical Tierra Blanca structures were identified at sites CA-09–52, CA-09–70, CA-09–71, CA-09–73, and CA-09–77 in the Nanchoc area (see Chapter 11) and typically characterized by rectangular structures with internal segmentation (Figs. 6.5 and 6.6). These structures were radiocarbon dated to between 7,800 and 5,000 years ago. Another similar structure was identified at site JE-890 in the upper reaches of the Q. del Batán, although no associated radiocarbon date was obtained (Fig. 6.7; Stackelbeck 2008). Twenty-three similar structures were also found elsewhere in the Zaña and Jequetepeque valleys. Based on the architecture and associated diagnostic unifacial lithics, these sites probably date to the Tierra Blanca phase.

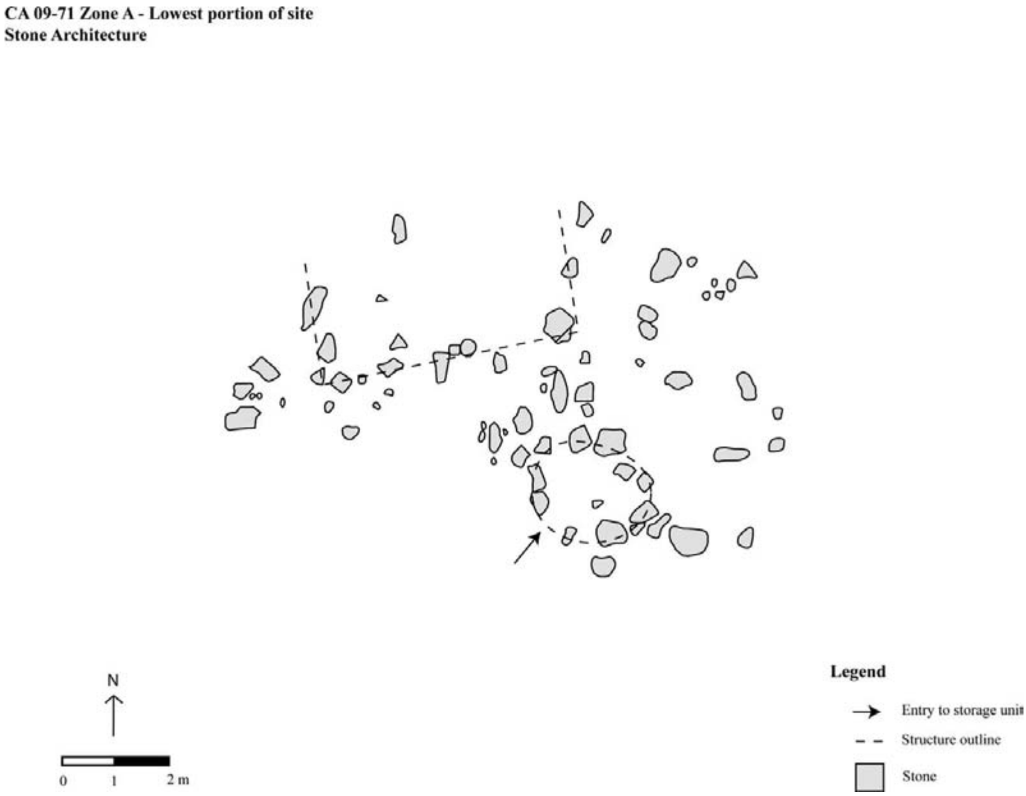


Figure 6.5. Rectangular house and storage unit of the Tierra Blanca phase at site CA-09–71.

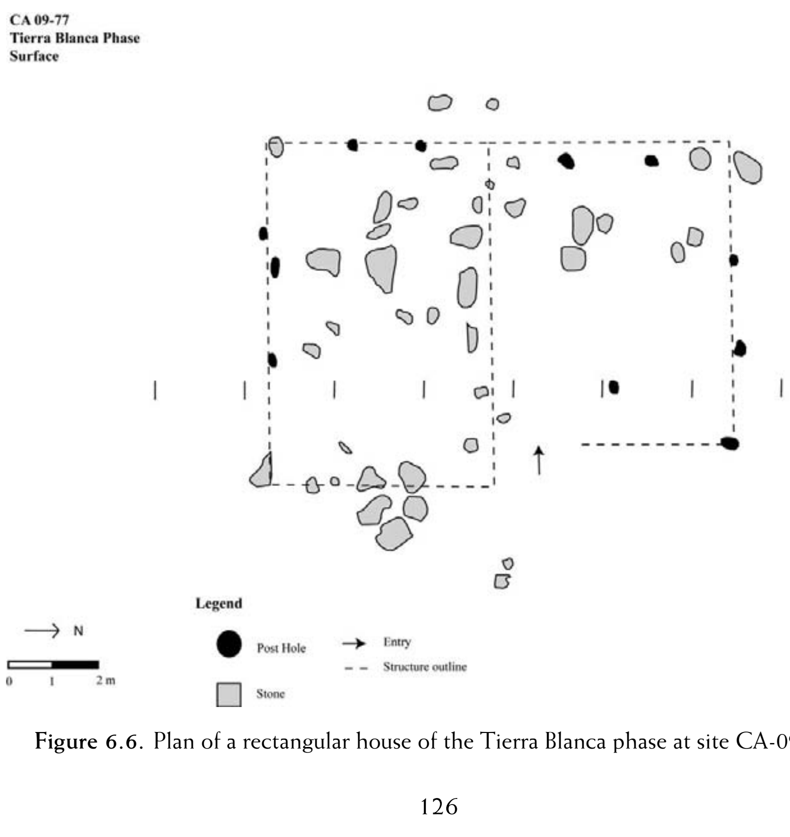


Figure 6.6. Plan of a rectangular house of the Tierra Blanca phase at site CA-09–77.

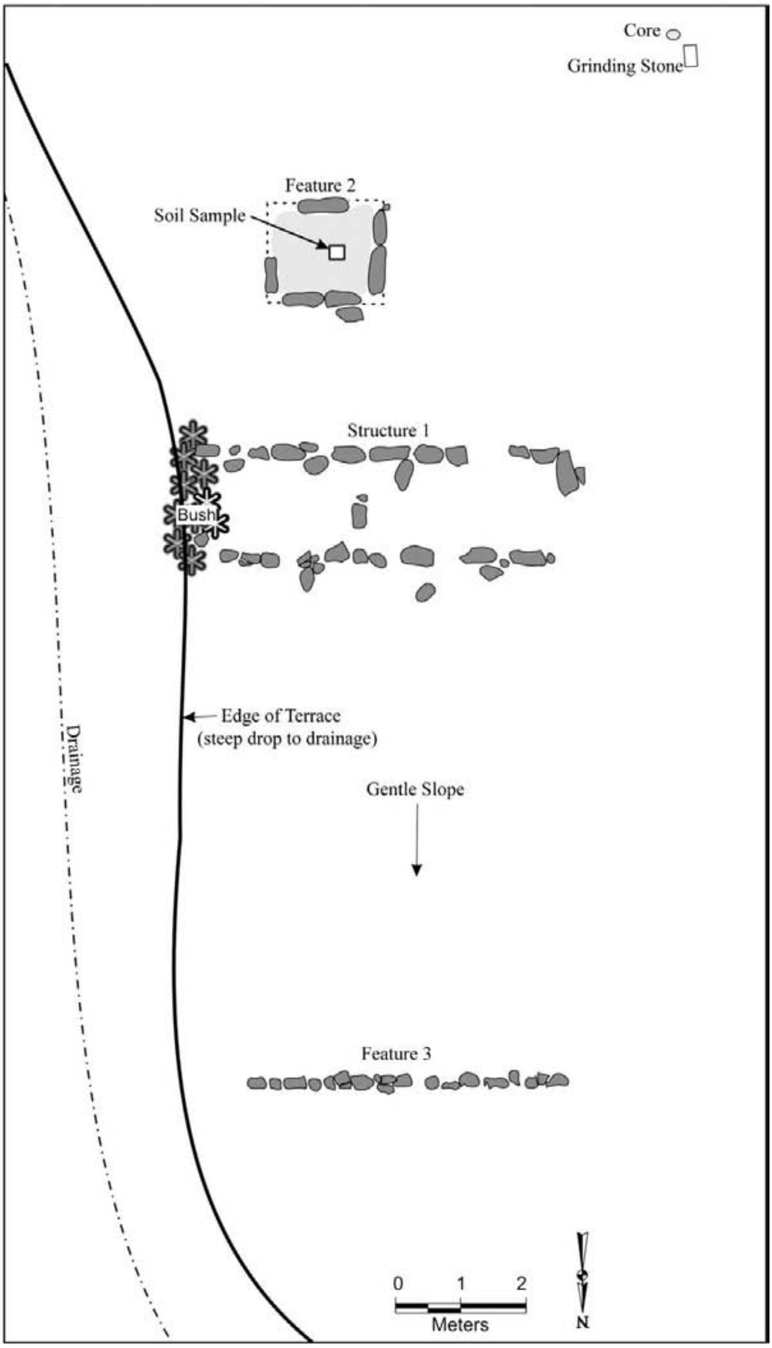


Figure 6.7. Architectural plan at site JE-890.

Two sites warrant special mention: CA-09–71 and CA-09–72. These two sites exhibit multiple rectangular to semi-rectangular house structures, several of which are agglutinated to form a larger multi-household unit perhaps approaching the idea of a small "village," though the latter does

not formally appear until the end of the Tierra Blanca phase (see Chapter 11). Both sites contain six and eight structures, respectively, with CA-09–71 having the best defined architectural plans. Excavations in CA-09–71 revealed cultigens, animal bones, and lithics commingled in thick house floors dating to ~7500 +/– 60 BP (Beta-60887). The structures at these sites range in size from 2 by 3.2 m to 3.1 to 6.0 m. The floors are between 18 and 26 cm thick and the cultural deposits often reach 70–90 cms in depth. Both inside and outside stone-lined storage facilities are found at the Tierra Blanca sites.

The best examples of Tierra Blanca stone-built structures are in the Tierra Blanca quebrada in the Nanchoc Valley. All measure between 2 to 3 m in width and 3 to 6 m in length and were usually segmented. All have clearly defined entrances and were surrounded by unattached storage pits, other miscellaneous structures of varying size, and activity areas defined by lithic scatters, grinding stones, and other debris. The internal floor deposits of these structures are generally much thicker than they are for Las Pircas and certainly Paiján houses, with deposits ranging between 30 and 90 cm thick as opposed to 20–40 cm and 5–18 cm for the latter two phases, respectively. The late Las Pircas and Tierra Blanca floor deposits also are not laminated like those of the early Paiján floors in the Zaña Valley, but are thick, continuous floors, suggesting more intensive and prolonged occupation. Finally, Tierra Blanca Phase houses tend to form tighter spatial clusters located closer to the valley floor, presumably for the purpose of more direct access to fertile soils and to associated irrigation canals. Although Las Pircas phase houses suggest a similar pattern, they are not as closely aggregated and they are scattered across wider expanses of the upper and middle reaches of the quebradas, and they are more closely associated with springs and stream drainages. Tierra Blanca phase houses cluster in groups of five to eight units along the same stream or adjacent streams, suggesting the beginnings of a community organization. Excavations show that they tend to be associated with a wider diversity and greater abundance of artifactual debris, indicating longer occupational cycles and more intensive activities than earlier house structures.

Of particular interest were structures exhibiting internal floors appearing more as "bone beds": that is, these floors contained high amounts of burned, fragmented, and cut human and animal bones, as if they were deliberately deposited as bone middens (Fig. 6.8). In addition, Tierra Blanca houses contained coca leaves and prepared concretions of lime for the extraction of alkaloids in the leaves (Dillehay et. al. 2010). Concerning the associated artifacts, lithics were generally less formal, expedient unifacial

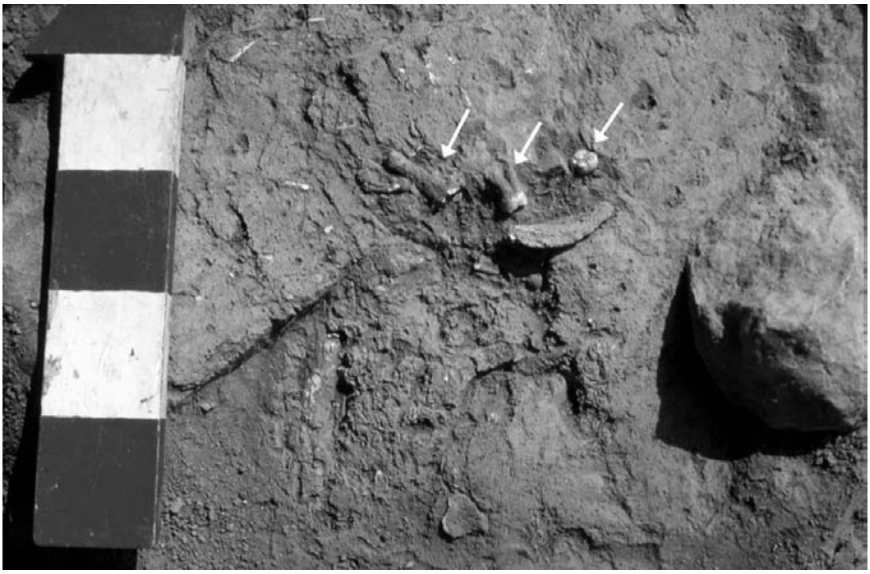


Figure 6.8. Human bone "bed" in floor of CA-09–77.

tools. Carbonized and noncarbonized plant remains and animal bones were prevalent, with grinding stone fragments recovered from just outside the entryways. Most of the burned plant remains were recovered from internal hearths or from under rocks that had fallen from the side walls of the architectural foundations.

Accepting the characterization that Tierra Blanca phase houses represent multi-household community formations, this shift in settlement co-evolved with other important developments. These developments include new conceptions of land use associated with irrigation agriculture; changes in perception of the human body and its treatment (or manipulation) at death; reduced influence from external sources (based on relative absence of exotic materials); probably increased public gatherings at the Cementerio de Nancho site; and the manufacturing of lime for use with coca chewing. No less significant was the development or adoption of cotton and coca, two local products, and the building and maintenance of irrigation canals.

Though technologically simple in form, these Tierra Blanca houses reflect a social process invoking accepted social representations of how things should be done (Lemonnier 1992). A social logic of labor was involved in constructing and maintaining houses. With available materials and tools, people could have built a wide range of shelters: skin-covered huts, rectangular stone room-blocks, lean-tos, subterranean huts, and so forth. By examining the architectural forms that Tierra Blanca populations chose and their spatial configuration, we can make some interpretations

regarding the social logic behind their construction. The apparent aim was not to create a concentration of people bounded by an architectural form into a relatively static grouping of contiguous living units or a village. Rather, architecture involved modularity: small, spatially separate but socially and economically integrated houses. Even when people aggregated into loosely scattered communities, the population may have consisted of relatively few households, and there continued to be an architectural emphasis on the house.

PUBLIC ARCHITECTURE

Ritualized use of communal space at the Cementerio de Nanchoc site (CA-09–04) in the upper middle Zaña Valley intensified during the Las Pircas phase (see Chapter 7). This activity culminated in the expanded construction and use of two low mounds and adjacent workshop area during Tierra Blanca times (Dillehay et al. 1998). Public rituals associated with the low mounds at the CA-09–04 site were "manifested to an unprecedented degree" between 7600 and 6500 BP at the beginning of the Tierra Blanca phase (Dillehay et al. 2007: 1892). This activity involved lime production, for coca leaf consumption, by multiple households who likely occupied the nearby domestic sites (Dillehay et al. 1997; Rossen et al. 1996). As noted by Dillehay and others (2007: 1892), "public ritual coevolved with agriculture and wider community developments." Such intermittent communal behavior likely facilitated increased social cohesion, and perhaps an increased sense of place and territoriality.

Significantly, the CA-09–04 site is not the only mound locale in the study area. There are Macauco 1 (CA-09–15), which was tested and radiocarbon dated to ~7,200 years ago; Chical 1 (CA-09–13), undated but associated with Ayampitin-like projectile points dated elsewhere in the Central Andes between ~9,400 and 6,000 years ago (González 1966); and other undated Preceramic mounds (Netherly and Dillehay 1986a,b). Preceramic mounds also appear in the vicinity of Espinal and Viru in the middle sector of the Zaña Valley and in the Bolivar area of the upper Nanchoc Valley (Netherly and Dillehay 1986a). All of these are earthen mounds with internal layers of soil and rock fill. These do not appear to be burial mounds but possibly residential or ceremonial structures. The presence of several mound sites and the appearance of irrigation canals suggests the establishment and spread of a commitment to public works.

By comparison, communal behavior is thought to have been central to Valdivia society (~6000–4000 BP) in southern Ecuador, based on evidence

for public ceremonial activities at sites such as Real Alto (Damp 1984). In another example from the south-central highlands of Peru, public space was initially demarcated at Asana around 5400 BP with a prepared clay floor and surface hearths, and likely was used as some sort of "dance ground" that was open and inclusive (Aldenderfer 1991: 227). By about 5000 BP, however, this open public space became formalized through the construction and ceremonial use of a low platform mound and associated features. Aldenderfer (1991: 254) suggests that the use of this space "transformed to a more closed, controlled pattern," perhaps indicating that ritual power was being wielded by select individuals. While the Nanchoc evidence does not seem to indicate the same kind of selective power dynamic at the CA-09–04 site, it is clear that by middle Preceramic times, the phenomena of public space and ritual were becoming increasingly important in the organization of Andean societies (Dillehay 1992).

BURIAL PATTERNS/TREATMENT OF THE DEAD

In addition to the communal rituals of middle Preceramic populations at the Cementerio de Nanchoc site, and perhaps other mound sites in the valley, Tierra Blanca populations also participated in mortuary practices (Rossen and Dillehay 2001b). Rossen and Dillehay assessed differences in these practices from early through late middle Preceramic times based on recovered human remains from Las Pircas and Tierra Blanca phase sites. Human skeletal remains were found at three Las Pircas (~9800–7800 BP) sites (CA-09–27, CA-09–52, and CA-09–28 [Rossen and Dillehay 2001b: 64]), and are discussed in detail in Chapter 8. Fewer skeletal remains were recovered from Tierra Blanca sites; these consisted of an assemblage of hundreds of highly fragmented human bones, which were recovered from house floors at sites CA-09–77 (Rossen and Dillehay 2001b: 69) and CA-09–71 (see Chapter 8). At least some of these remains are from subadults, and many show evidence of having been burned and cut (Rossen and Dillehay 2001b: 69; see Chapter 8).

Based on the remains from this site, Rossen and Dillehay (2001b: 70) propose that burial practices of the Tierra Blanca phase were not as complex or systematic as those of their Las Pircas predecessors. Rather, human remains were broken and trampled into domestic floors, without any other apparent special treatment. The fact that fragmented, burned human remains were found in association with other faunal remains, and processed and deposited in much the same fashion, suggests to Rossen and Dillehay (2001b: 69) and Verano and Rossen (Chapter 8) the possibility that Tierra

Blanca populations may have continued to practice cannibalism, though the context had changed. Unlike their predecessors, Tierra Blanca populations lacked the kinds of diverse exotic items found in Las Pircas assemblages, perhaps indicating that they no longer practiced the same kind of household ritual activity – probably associated with gardening – that Dillehay and others (1998; see Rossen 1991) posited for this earlier phase. However, the haphazard burial of human remains in house floors, cannibalized though they may have been, may indicate a continuation of some type of ritualized household behavior. These burial practices are seen as part of a larger process of middle Preceramic ritual, which may have been related to the uncertainties that often accompany new or changing circumstances, including the shift to plant cultivation (Rossen and Dillehay 2001b: 70).

SUMMARY

Although the patterns evident among Tierra Blanca sites of the Q. del Batán and Q. Talambo areas of the Jequetepeque Valley do not mirror precisely those of the Zaña/Nanchoc Valley (Dillehay et al. 1989, 1998, 2005, 2007; Rossen 1991; Rossen and Dillehay 2001b), they are sufficiently similar and close geographically and temporally to suggest contact, if not actual incorporation within the same overall settlement system. The Tierra Blanca phase witnessed an expansion of the repertoire of domesticated plants to include coca and cotton, and intensification in the methods of producing them (Rossen and Dillehay 2001b). Waisted hoes, garden furrows, dating as early as 8500 BP at CA-09–52, and irrigation canals and agricultural fields dating as early as 6500 BP (but securely at 5800–5000 BP), signal an increased commitment to plant food production during the middle Holocene (Dillehay et al. 2005). Although no domesticated macro-plant remains were recovered from excavation contexts in the Q. del Batán and Q. Talambo areas, the identification of two rudimentary canals and the presence of grinding stones at JE-901 and JE-393 (Stackelbeck 2008: Figures 6.9, 6.17, and 6.18 and Table 7.33), dating to ~7300 BP and 5200 BP, respectively, suggests that some horticultural activity probably took place at these sites. The floral and faunal evidence from Tierra Blanca sites in these areas indicate that people relied primarily on locally available terrestrial resources (i.e., cactus fruits and leaves, *algarrobo* beans, snails) and some fish (not necessarily marine).

This time period in the Zaña Valley is further characterized by changes in technology, domestic and public architecture, and burial practices. The chipped lithic technology of the Nanchoc area continued to be unifacial,

although the tools were cruder and more expedient compared to their predecessors (Rossen and Dillehay 2001b: 68). In keeping with intensified plant production, Tierra Blanca people in the Nanchoc basin utilized more and larger groundstone tools. There was also a shift from small, elliptical *quincha* dwellings to larger, segmented, nearly rectangular house styles. The communal construction and use of two low mounds at the Cementerio de Nanchoc site spans the transition from the late Las Pircas phase to the Tierra Blanca phase. Periodic ritual activity was carried out at these mounds and included the specialized production of lime, presumably for use as an activating agent in the use of coca. There is limited evidence for exotic goods in Tierra Blanca phase deposits. Additionally, treatment of the dead was more haphazard (Dillehay et al. 1998; Rossen and Dillehay 2001b). At sites CA-09–77 and CA-09–71, highly fragmented human remains were recovered from house floors. Many of the remains were burned and commingled with faunal remains, suggesting possible evidence for cannibalism (Rossen and Dillehay 2001b: 69; see Chapter 8).

The intensified occupation of the Nanchoc area during the Tierra Blanca phase and concomitant decreases in occupation of the Q. del Batán, Q. Talambo, and other sectors of the study area suggest a shift in settlement patterns, albeit not to a point of abandonment of the latter. Rather, it seems likely that the conditions in these latter areas may simply have not been conducive to the intensive occupations that characterized these same areas during the terminal Pleistocene to early Holocene. Water likely continued to be present during the middle Holocene, but perhaps in decreasing quantities or on an intermittent basis in the lower valley areas. The conditions of the Nanchoc basin, however, appear to have been sufficient to support an intensified occupation during the Tierra Blanca phase. While some aspects of Tierra Blanca culture, such as irrigated plant cultivation and the construction and use of communal architecture, were becoming increasingly complex, others were not. For example, the chipped stone tool technology of this phase was crude and more expedient. In addition, the treatment of the dead was less sophisticated, perhaps indicating increased social tension and conflict. Taken collectively with the ebb and flow of cultural changes observed for the project area since the late Pleistocene, the patterns we observe do not support a straight line of emerging regional complexity but rather a complex combination of social, economic, settlement, and technological adjustments. Around 5000 BP, most of the Tierra Blanca phase sites in the Nanchoc area were abandoned. Based on diagnostic lithics and radiocarbon dates from terminal Preceramic sites in the Cerro Guitarra (see Chapter 7) and Oyotun areas (e.g., Macuaco 1 and 2, Chical 1) of

the lower and middle valley, respectively, and in the upper valley (e.g., La Toma), it appears that Nanchoc and other valley inhabitants were moving to live adjacent to more fertile and larger fields (see Chapter 7), probably utilizing irrigation canals now drawn from the main Zaña river for crop production. Figure 6.1 shows the location of the lower, middle, and upper valley terminal Preceramic and early Initial Period sites, places that were previously unoccupied or minimally exploited.

CHAPTER SEVEN

Preceramic Mounds and Hillside Villages

Tom D. Dillehay, Patricia J. Netherly, and Jack Rossen

Two localities warrant special attention because they are unique in function and meaning to this study and the project area, and because they do not sufficiently fit into the chronological phase schemes presented in previous chapters. The first site, which has been referenced several times in published articles and this book, is Cementerio de Nanchoc (CA-09–04) that dates from the late Las Pircas phase to the end of the Tierra Blanca phase and is located in an isolated place on the north side of the Nanchoc Valley. It is the largest and most elaborate mound and public site of the middle Preceramic period in the area and is associated with the specialized activity of producing lime, probably in a ritual setting. This site was built and utilized by residents who likely lived directly across the valley. The second site is Cerro Guitarra (PV-19–54), a domestic village and perhaps ritual locale that dates to the terminal Preceramic and aceramic periods. It is the only village site recorded in the two valleys under study (a possible exception is site JE-734 in the Jequetepeque Valley but this has not yet been confirmed by excavation). Although Cerro Guitarra dates to the end of the Tierra Blanca phase, its architecture, lithic technology, and site plan do not fit within the cultural scheme of this phase and thus merit a separate discussion.

CEMENTERIO DE NANCHOC SITE: CA-09–04

Site CA-09–04 is located on the lower slope of a small alluvial fan on the north side of the Nanchoc Valley opposite the domestic sites in the Q. Las Pircas and Q. Tierra Blanca on the south side of the valley (see Fig. 6.1 in Chapter 6). The location of the site provided direct access to the highland areas situated ~1 to 5 km to the north at elevations of 800 to 2,000 masl, to the valley floor of the Nanchoc River located ~1.5 km

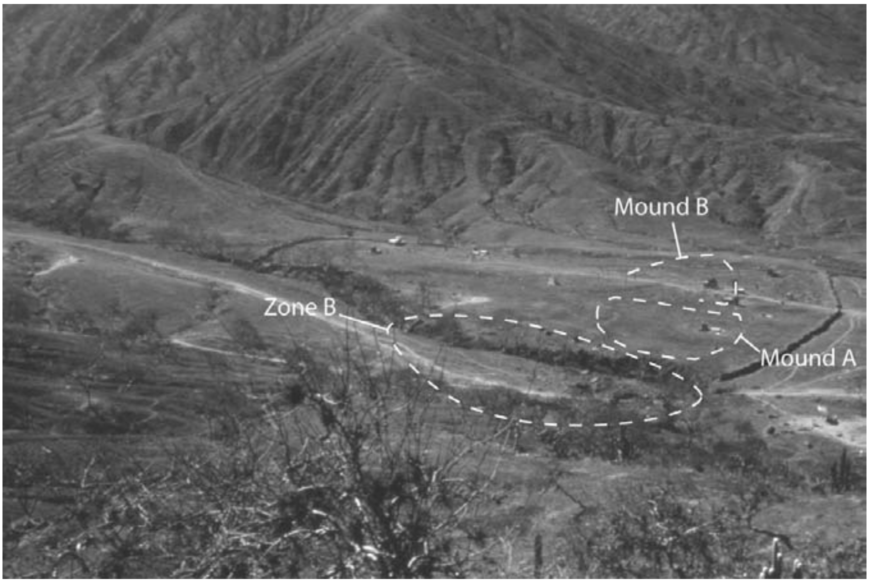


Figure 7.1. General shot of Mounds A and B at CA-09–04.

to the south, and to the quebrada fans ~3 to 4 km across the valley where the majority of the domestic sites are located. The site is divided into Zones A, B, and C, which are situated on the east and west terraces of a small stream dissecting a small alluvial fan. Zones A and C comprise two low subtriangular stone-faced earthen mounds; Zone B is a workshop area characterized by buried deposits of hearths, light lithic scatters, burned and unburned calcite, and stains (Figs. 7.1 and 7.2). The site was first excavated by Dillehay and Netherly in 1981 and 1985 (Dillehay et al. 1989). The modern-day town of Nanchoc has placed its cemetery in the fan where the mounds are located, thus initially suggesting the name Cementerio de Nanchoc site. Since the site has been published before, a brief description of the findings is given, as well as new C^{14} dates and other results.

Zones A and C: The Dual Mounds

Two artificially constructed mounds, Mound A (Zone A) and Mound B (Zone C), are located in this zone (Figs. 7.1 and 7.2). The long axes of both mounds are oriented ~30 degrees northeast to southwest of magnetic north. The exterior edges of both mounds were faced with unmortared standing field stones between ~0.60 and 1.00 m in height set into the earthen mound with a flat surface to the exterior.

Mound A is the more easily distinguished of the two structures (Figs. 7.1, 7.2), defined by three tiers ascending from the southwest to the northeast.

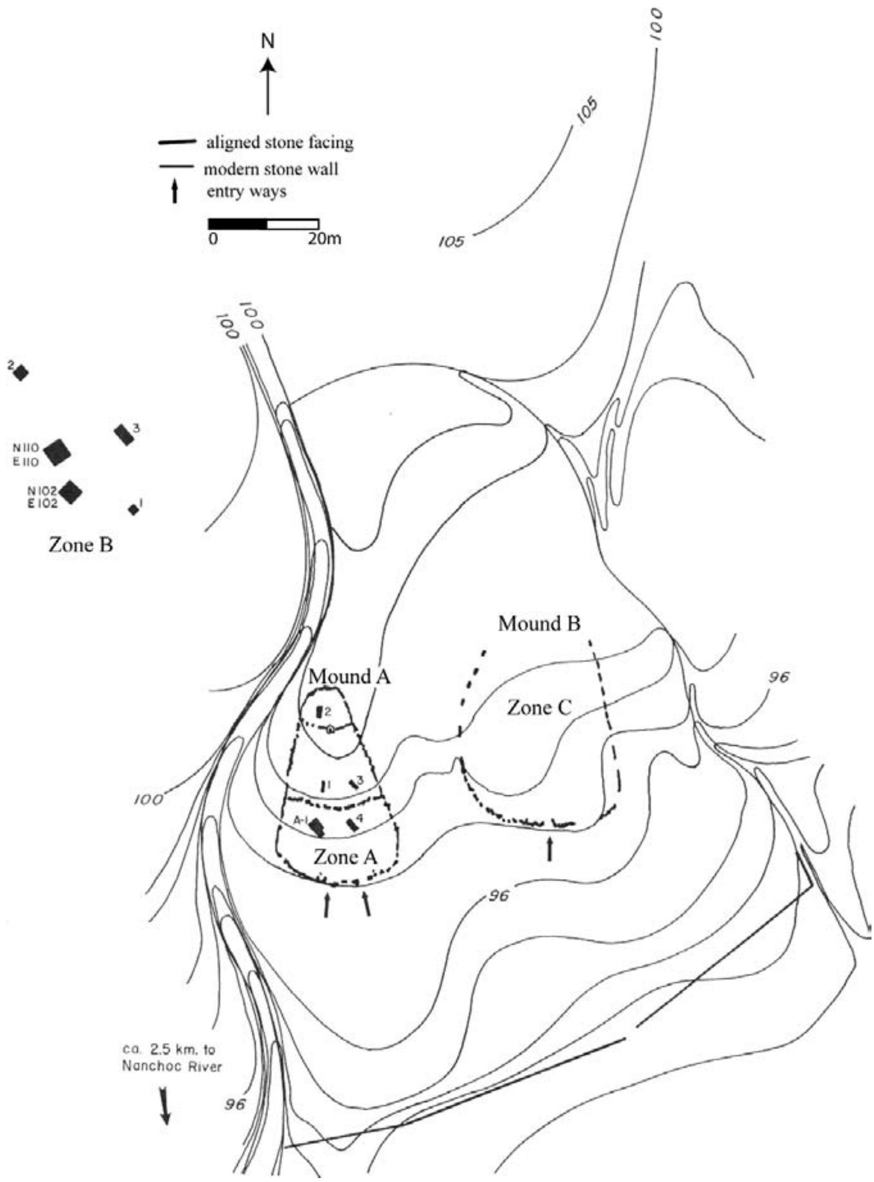


Figure 7.2. Plan of Zones A, B, and C and Mounds A and B at CA-09–04.

It lies on the edge of a small stream that dissects the quebrada fan (Fig. 7.1). Mound A is 32 m long and 22 m wide and measures 1.3 m high from the summit of the northernmost and highest tier to the ground level (Fig. 7.3). From the lowest to the highest, the three tiers are ~55 cm, 90 cm, and 1.3 m in height. A large standing stone at the back of the third tier was ~1.3m high and raised the apparent visual height of the third tier. When the authors first studied the mounds there were low dual ramped entryways onto the lower two tiers of Mound A from the southwest, defined by

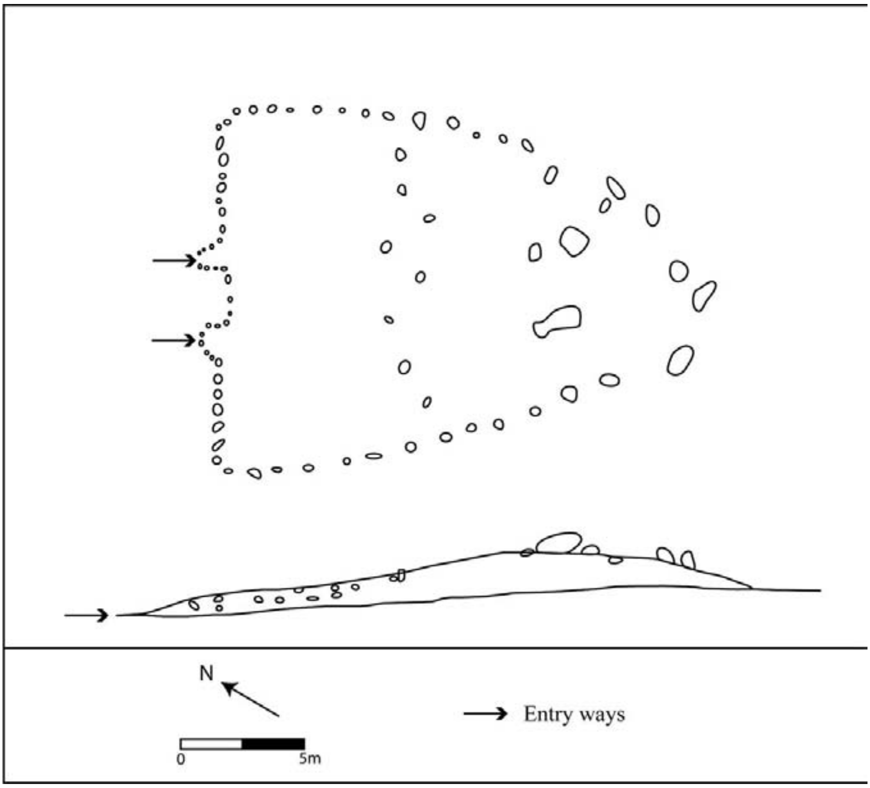


Figure 7.3. Plan and profile drawing of Mound A in Zone A.

standing stones ~30–40 cm tall, placed at the sides of the entry. These ramped entries have now been partially destroyed by modern-day removal of the stones and slumping (Fig. 7.4.) The dual entrances on each tier were not aligned to those below (Fig. 7.2). The entryways on the second tier were somewhat inset. Low stone steps led from the first tier to the second at each entryway. The northernmost or highest tier of Mound A was entered through two openings defined by four large (~1 m high) upright boulders. Some of these large stones are still visible in Figure 7.4.

Mound B is currently the cemetery for the town of Nanchoc and thus has been severely damaged and unavailable to archaeological excavation. Although modified, the size of Mound B is estimated at 35 m long, 31 m wide. Originally, it was at least as high as Mound A (Fig. 7.2). If anything, use as a cemetery has lowered this mound. At least one stone-faced entryway to the second tier was observed on Mound B.

During the 1981 and 1985 field seasons, testing operations at Mound A included four pits and small block excavations placed on the three tiers of Mound A. Three artificial strata were defined: Stratum A-I, Stratum A-II,

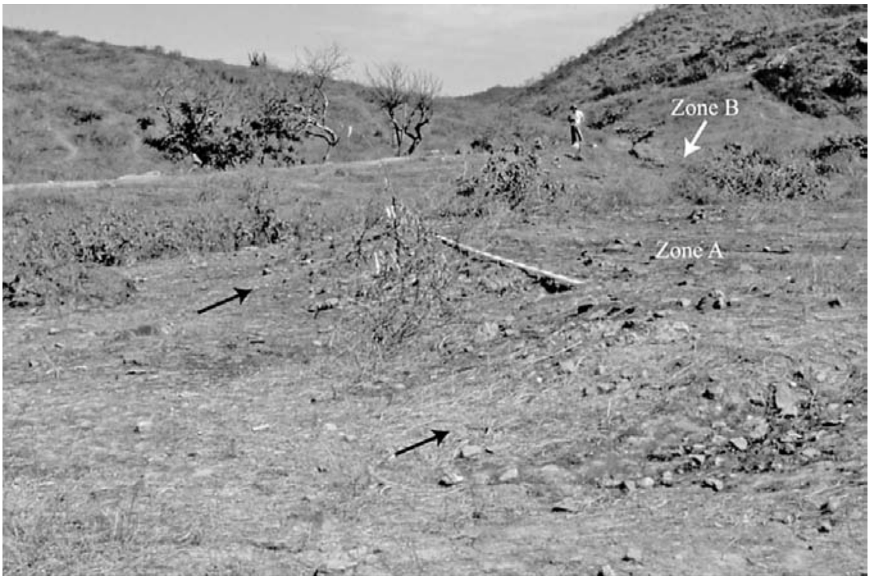


Figure 7.4. Profile view of Zones A and B. Arrows point to the dual entrances onto the lower tier of Mound A.

and Stratum A-III. Two underlying natural strata were present: Stratum A-IV and Stratum A-V (Fig. 7.5). The two upper strata were compact use-floors containing a few unifacial flakes made of local basalt and andesite exhibiting microscopic bits of burned calcite or lime powder on their worked edges (Fig. 7.6). Small, amorphous, reddish burned stains measuring 12 by 20 cm to 15 by 35 cm were documented on the use-floors of the mound. Also recovered from Strata A-II and A-III were five clear rock crystals, which may reflect a special ritual function (Rossen 1991: 599–601).

Stratigraphic profiles of the excavations revealed an artificial mound built in three stages. The first stage shows the natural ground surface (Strata A-IV and A-V: alluvial silt and travertine overlying bedrock), which was leveled and then overlaid by a cultural stratum of brown silt, ash, and cultural debris (Stratum A-III). Excavation of Mound A suggests that it was built upon a paleosol (Stratum A-IV) that was formed under grass vegetation. This soil horizon was probably utilized before the mound was built as indicated by the presence of Feature 1A. The pre-mound use of the area probably corresponds to the initial activities recorded in Zone B and dated to the late Las Pircas phase (see below). Intruding into Stratum A-IV was Feature 2A associated with Stratum A-III and defined by ash and charcoal. Stratum A-IV also contained *Coleoptera* beetle larvae, an indicator of more

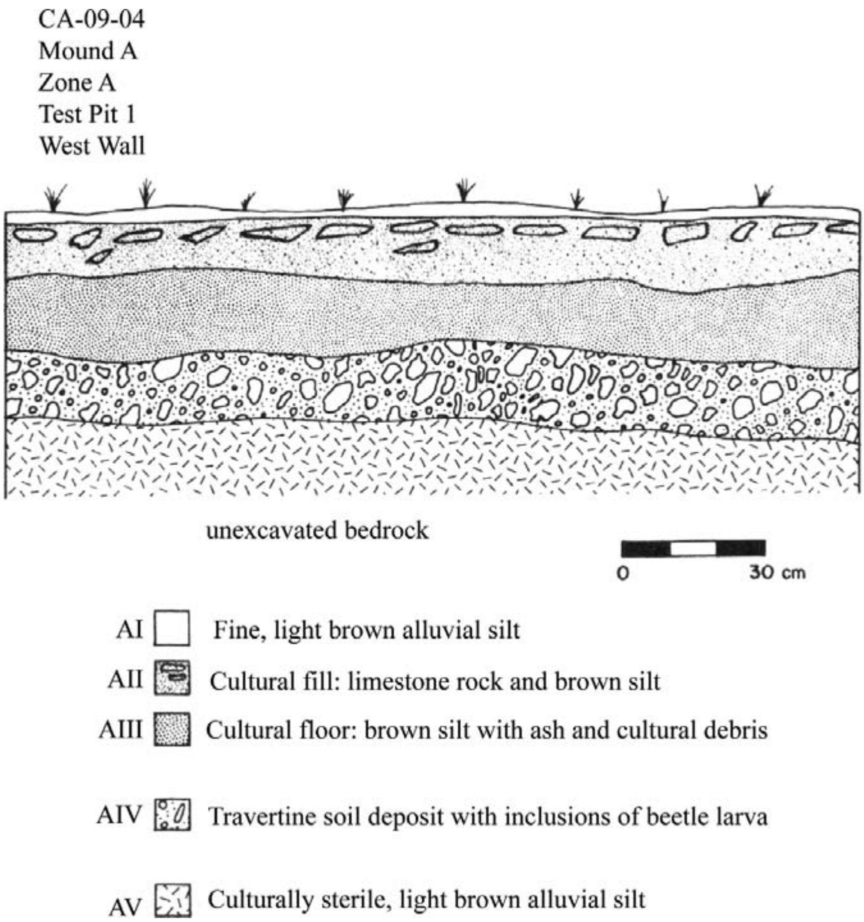


Figure 7.5. Stratigraphic sequence in Mound A.

humid conditions. Charcoal from the feature intruding into Stratum A-IV was radiocarbon dated to 8691–8203 BP (UCR-2371). This represents the first modification of the natural ground surface and places the initial use, if not construction, of Mound A in the late Las Pircas phase. Next was an artificial fill, Stratum A-III, which contained deliberately placed limestone slabs, burned and unburned rocks, lithic flakes, and other debris and stains. The vertical facing stones defining the exterior edges and the interior segments of the mound were embedded in this stratum. Charcoal from Feature 3A in this stratum dated to 7613–7324 BP (Beta-40626) or the early Tierra Blanca phase. Next is Stratum A-II, which was intentionally capped by stone slabs. Three early Huacaloma incised sherds of the Initial Period, dating between 4,500 and 4,000 years ago, were recovered from the surface of Stratum II, suggesting that the mound was briefly used and abandoned

during this period. Stratum A-I is a fine colluvial silt that covered Stratum A-II and sealed the mound.

We do not know if the subtriangular shape of the mound was formed at the outset of mound construction and use, or if the structure was simply a low rise and the subsequent layers and stone-line rocks altered its form. The penultimate construction phase (Stratum A-III) is associated with Feature 3A and with the stones placed around the exterior edge of the mound. Conductivity and magnetometer studies have revealed a U-shaped pattern of anomalies associated with Stratum A-III, parallel to the northeast-southwest longitudinal axis (see discussion later in the chapter). As suggested by several features and anomalies recovered in the test pits and block excavations, these are probably post molds and hearths associated with structures built during the primary use period of Stratum A-III.

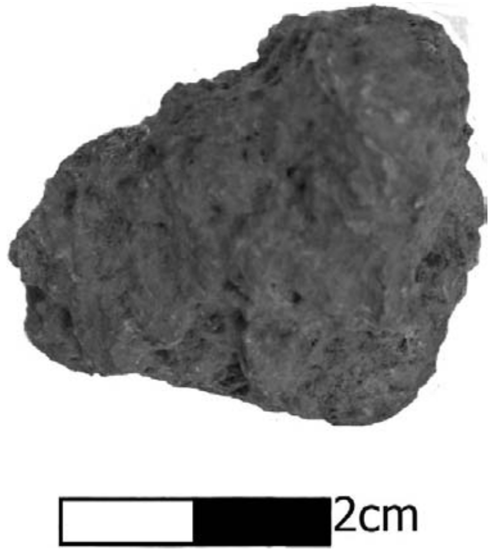


Figure 7.6. Chunk of burned lime or calcite from Zone B at CA-09–04.

As noted above, no excavations were carried out in Mound B because it is a modern cemetery. However, on different occasions during surveys in the area and the excavation of Mound A, the subsurface deposits of the mound were observed in freshly dug or eroded graves. The observed stratigraphy is similar to that recorded in Mound A. The stone facing remained on only a portion of the exterior edges of Mound B at the time of the authors' initial investigation. Many stones had been removed to cover graves.

Feature Descriptions

Feature 1A was recovered at the base of Stratum A-IV below the first mound layer and suggests pre-mound activity during the late Las Pircas phase. The feature is a shallow depression and thin lens of ash, small flecks of charcoal, and small chunks of burned lime or calcite. It measured ~22 by 34 cm.

Feature 2A was a shallow pit that possibly was a posthole. It was 17 cm deep, 12 cm in diameter, and associated with Stratum A-III and the Tierra Blanca phase. The sediment fill contained ash and charcoal.

Feature 3A is a shallow hearth-like pit filled with charcoal and ash. It measures 2 cm thick and 22 cm wide and is associated with Stratum A-III.

Several other minor stains, shallow depressions, and ashy spots were observed in Strata A-II and A-III. None of these anomalies were as well defined and intact as Features A-I-III and thus were not given formal feature designations.

NON-MOUND EXCAVATION AND WORKSHOP IN ZONE B

Subsurface excavations in Zone B were primarily designed to discover the nature and extent of the buried cultural debris. Although no mounds were recorded in the zone, several subsurface features were excavated, as well as eighty-two unifacial flakes, forty-one burned and unburned chunks of calcite or lime, and several hearths and inorganic stains. Zone B measured about 50 by 60 m in size, with 70 to 80 cm thick cultural deposits.

A culturally sterile alluvial silt corresponded to the deepest Stratum B-IV. Above this layer was the earliest cultural layer, Stratum B-III, containing basalt and andesite, secondary flakes with burned lime caked on their used edges. Fragmented milling stones with burned lime smeared across their surface, post molds, ash stains, and hearths were also excavated in this Stratum B-III. Casts of *Coleoptera* (beetle) larvae were observed only in this stratum of Zone B. These beetle casts, left by the larvae, indicate a moist environment. They were also present throughout domestic middens of the late Las Pircas and early Tierra Blanca phases (Rossen 1991; see Chapter 3). Stratum B-III stratigraphically corresponds to Stratum A-IV in Mound A (Fig. 7.7. Three stratigraphically located radiocarbon dates on charcoal from three hearths dated from the lower to middle to upper levels of Stratum B-III were 8274–7677 BP (Beta 5708), 7739–7327 BP (Beta 4562), and 7824–7500 BP (Beta 3825), respectively. The latter two dates from the middle and upper levels agree with the measure of 7613–7324 BP (Beta 40626) for Stratum A-III in Mound A and pertain to the Tierra Blanca phase.

Feature Description

Feature 1B in Stratum B-III, Test Pit 1B, was roughly circular in shape, measuring 41 cm in diameter; the sediment fill yielded ash, fire-cracked rocks, and charcoal, and seven unifacial andesite and basalt flakes, four with burned lime caked on the worked edges.

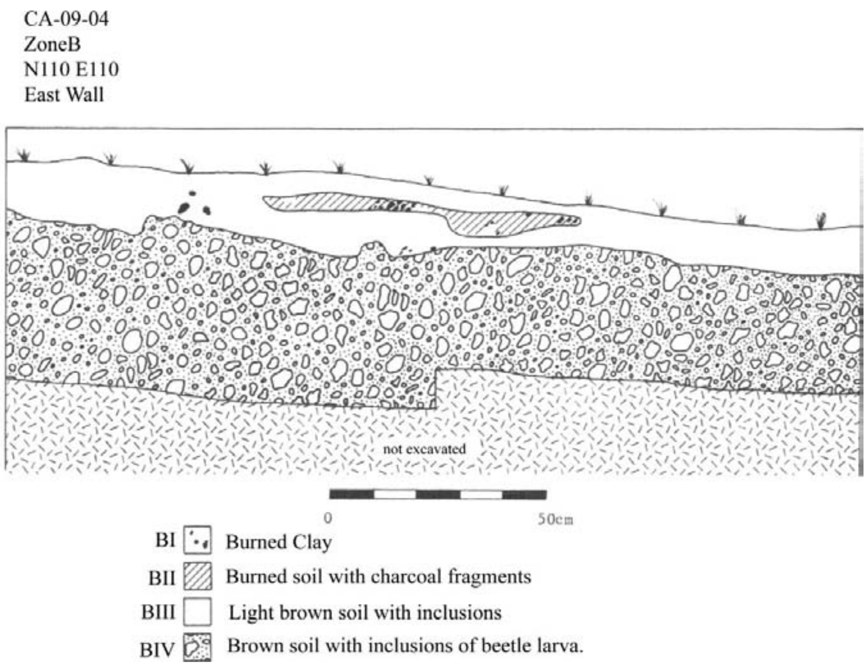


Figure 7.7. Stratigraphic sequence in Zone B, CA-09–04.

Feature 2B in Stratum B-III, Test Pit 1B, was a shallow basin 3 cm deep and containing ash, fire-cracked rock, and flecks of charcoal (Fig. 7.8). It was amorphous in form and measured about 42 cm in diameter. Four unifacial basalt flakes with used distal edges were associated with the feature.

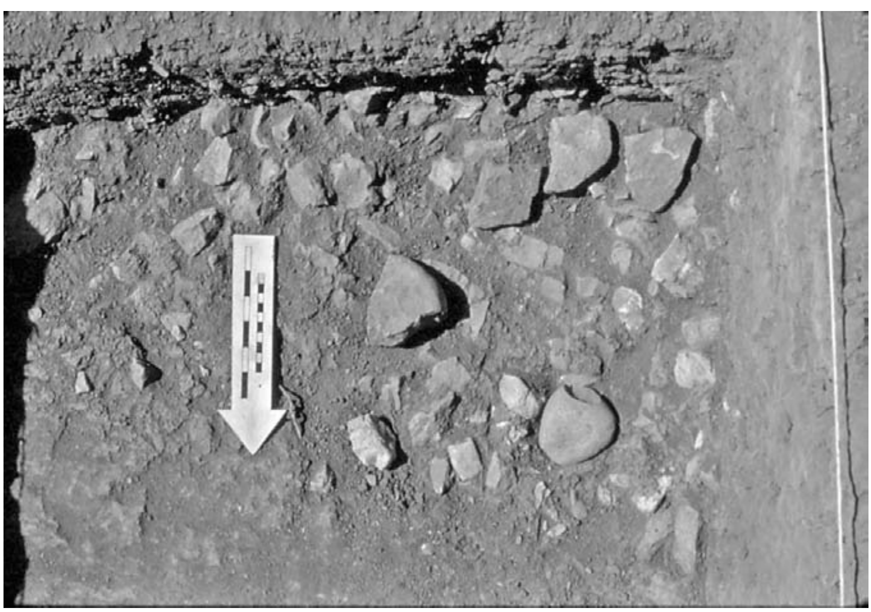


Figure 7.8. Feature 2B in Zone B, CA-09–04.

Feature 3B also was located in Stratum B-III, Test Pit 1B. This feature contained fire-cracked rock, ash, and charcoal and measured 2 cm thick and 34 cm in diameter. The feature was void of artifacts.

GEO-CHEMICAL AND MICRO-RESIDUE EVIDENCE FOR CALCITE (LIME OR *CAL*) PRODUCTIONS

We interpret the high content of burned calcite, or lime, at CA-09–04 as an extractive agent chewed with coca leaves (Dillehay et al. 2010). An alkali such as lime is required to extract the alkaloids from masticated coca leaves. Direct evidence of coca use is difficult to find archaeologically because the leaves leave few, if any, diagnostic starch grains, phytoliths, and pollen in archaeological sites. Seven coca leaves, recovered from sealed floors in two late Las Pircas houses across the valley, were directly dated through accelerator mass spectrometry (AMS) to 7763–7770 BP (Beta-226458) and 7746 – 7953 BP (Beta-226221; Dillehay et al. 2010). Directly associated with the leaves on the house floors were eleven chunks of burned calcite, which represent lime presumably processed for use with the leaves. Three other houses also yielded the remains of conically shaped lumps of precipitated lime dating as early as 7600 BP, but no coca leaves (Rossen 1991), although both coca leaves and chunks of burned calcite were recovered from later Tierra Blanca phase house floors. The same processed lime was excavated from the mounds and the off-mound activity areas at CA-09–04 and found on the edges of lithic tools recovered from these areas, revealing a direct connection between the mounds and the domestic sites for both the late Las Pircas and the Tierra Blanca phases (Figs. 7.6 and 7.9).

Figure 7.9. Baked "potash" lime or calcite from site CA-09–77.

Analysis of the sediments contained in the cultural layers of Mound A and Zone B shows high amounts of potassium and calcium in comparison to noncultural control sediments in off-site areas (Dillehay et al. 2010). The cultural layers had been calcium enriched, as a result of the extraction of lime from burned calcium-bearing rocks. The dense content of ash in and around the hearths explains the high amount of potassium in processing Zone B. Again, the high content

of calcium was interpreted as an extractive agent used with coca leaves. Additional evidence for processing lime is shown on the edges of several unifacial flaked tools, which exhibit scraped burned and unburned calcite powder, the same powder recovered from Mound A, hearths in Zone B, and floors in the Tierra Blanca phase houses across valley. Similar calcium enrichment of the soil was also recorded in late Las Pircas phase domestic middens at sites like CA-09–27 (Rossen 1991: 622).

Ethnographic analogy suggests that the calcite was used as an extractive agent to release the alkaloids in masticated coca leaves. These alkaloids have the property of enhancing the metabolism of high carbohydrate diets, raising the energy level for work and reducing fatigue. Today, among the Aymara of Bolivia and the Quechua of Peru, lime or *katawi* is prepared by burning calcium-bearing rocks and grinding them into a powder, which, in turn, is mixed with water and salt and condensed into small cake-like concretions (Antuñez de Mayolo 1981: 87–88; Baker and Mazess 1963). Archaeological lime was recovered from the site of Chiripa in Bolivia and dated ~3000 to 2750 BP (Browman 1981: 412, 1986).

GEOPHYSICAL SURVEY

As reported previously, magnetometer and resistivity studies carried out in both zones of the Nanchoc mounds resulted in the recording of several features, including those mentioned above. The patterning or data structure observed in the geophysical maps is typically the result of several sources, including geology (soil features), past cultural activities, and modern impacts to the site. Here are briefly described several cultural features and other anomalies that are most relevant to geophysical interpretation in Zones A and B.

The areas selected for survey were the main platform of Mound A and a 40 m transect of Zone B. The methodology employed was described previously (see Dillehay et al. 1989). Selected anomalies are slight depressions that were laid out in two parallel lines on Mound A (Fig. 7.10). These linear anomalies bear some resemblance to postholes and other features excavated in pits on the mound; they are probably associated with walls of a structure built on the mound. The fact that they are parallel and contiguous suggests that they are not just the accumulation of longitudinal bands of natural deposits.

Small positive monopolar anomalies like those observed in Zone B are difficult to interpret. These anomalies may represent the kinds of scattered

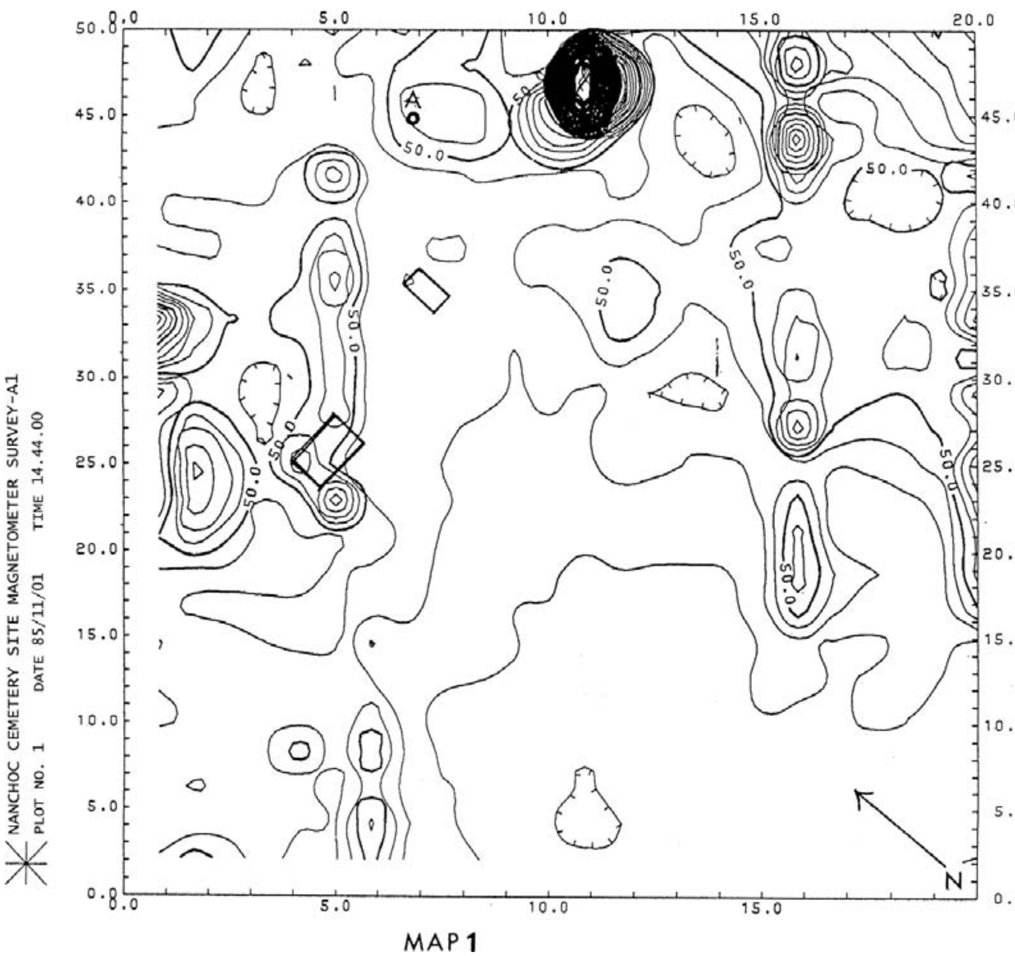


Figure 7.10. Plan of anomalous features revealed on Mound A by magnetometer survey.

remains of hearths, shallow pits, rock concentrations, and shallow, localized concentrations of burned or organically enriched materials and other features that were excavated in the zone. The negative monopoles may be features of other deposits characterized by fill that is less rich in organic and burned material than the immediate surroundings.

A semicircular area of subsurface anomalies was also documented by resistivity analysis in Zone B. Not known is whether this semicircle is a structure measuring about 15 m in diameter or simply a ring of features. As noted earlier, test pits excavated in the zone revealed anomalies in the form of hearths, stains, large postholes, and possibly rock concentrations showing a ring of small hearths. All anomalies in Zone B are associated with late Las Pircas and Tierra Blanca levels.

COMPARATIVE IMPLICATIONS OF THE CEMENTERIO DE NANCHOC MOUNDS

The authors have drawn attention to the Andean pattern of duality as expressed in the architecture and placement of ceremonial and public structures in an earlier publication. The Cementerio de Nanchoc mounds were presented as the earliest evidence for this practice (Netherly and Dillehay 1985, 1986b). While the final architecture visible in the mounds is late Preceramic in date, it may reflect later stylistic canons. Nevertheless, the mounds do conform to Andean canons of duality from the beginning: there are two mounds, and one (Mound B) appears to have been slightly larger than the other (Mound A). The architectural style of a tiered platform mound is a building style that appears to have begun in the Preceramic and was continued through later periods in the Zaña and Nanchoc regions. Prominent are the distantly paired mounds at La Toma and Uscundal in the Niepos highlands overlooking the head of the Nanchoc Valley (Netherly and Dillehay 1986b). Test excavations off the mound at La Toma reveal late Preceramic levels. In the Zaña Valley, there are two pairs of mounds at Macuaco I-II and Viru that also conform to this architectural pattern (see Chapters 6 and 11). Off-mound test excavations at Macuaco II also extended back to the Preceramic.

A more distant comparison can be made with the mound complex at Huacaloma. This mound complex is made up of six long tiered platform mounds arranged in a circle around what the excavators call a "great depression," probably a large borrow pit (Terada and Onuki 1982: Fig. 2). There is an additional pair of mounds to the southeast that may comprise a larger complex of eight mounds. The Aranjuez mound to the northwest would appear to be an outlier.

The Japanese Expedition excavated at the two southeastern mounds, which are clearly a pair and whose form is very similar to that of the Cementerio de Nanchoc mounds, although the larger mound is almost twice the size of Mound A in Nanchoc. Like the Nanchoc mounds this pair is unequal in size (Terada and Onuki 1982: Fig. 3). Deep excavations in the larger mound showed that it rested on a level that contained cultural material but no ceramics; the excavators thought this level might be aceramic, but it was probably Preceramic (Terada and Onuki 1982, Chapter 2 passim). The similarities in architectural plan and site layout with paired mounds at Huacaloma and CA-09–04 suggest that there may have been an ideological continuity as well. Furthermore, in societies

organized into moieties, as Andean societies were, each division was frequently represented by an equivalent structure, the difference in rank between the moieties being demonstrated by difference in relative size. The late Preceramic populations of the Nanchoc Valley and the upper Zaña Valley were probably in contact with highland communities and may have shared religious beliefs with them. The brief occupation or reoccupation of the Cementerio de Nanchoc mounds by a later group using early Huacaloma pottery suggests a continuity of tradition.

The other late Preceramic styles for temple complexes with sunken plazas, circular fire pits, or U-shaped structures appear not to have affected the study area. These different styles may well represent different religious traditions followed by a society with fundamentally similar social organization. These sites also demonstrate dual traits such as paired entrances and stairways, which are very extensive in the Andes.

Of interest, however, is V-71 in the lower Viru Valley, which would appear to be the work of a Preceramic population of equivalent size. This rectangular complex, of which only low stone walls survive, is very simple, yet rectangular plazas surrounded by low stone walls are a significant feature of Initial Period sites in the upper valley and above Huacapongo (Willey 1953: 41, 55). The Preceramic and early ceramic inhabitants of this valley may have been similar in scale, but they evolved a tradition independent from that of the Nanchoc/Zaña area and different from that of the Ancash and Huanuco highlands, the Santa Valley, and the Norte Chico.

Like V-71, the Cementerio de Nanchoc mounds are modest in scale, reflecting the small size of the supporting community. It is clear that the construction and renewal by rebuilding activities brought together people who may not have seen each other on a daily basis. Sharing the construction and renewal activities, as well as the activities involved in lime preparation and coca use, served to reinforce community bonds. In contrast, the early Preceramic irrigation systems, did not require community-level effort (Dillehay et al. 2008). Larger systems appear to have come after the Nanchoc population had begun to leave the area when bigger social groups built larger systems farther downvalley (Netherly and Dillehay 1986b; see Dillehay et al. 1989).

DISCUSSION

The CA-09–04 radiocarbon dates indicate the site was used over a considerable period of time, beginning in the late Las Pircas phase and ending in the Tierra Blanca phase. (The presence of the few early Huacaloma sherds

in the upper layer may indicate brief use of the site during the Initial Period.) There is no evidence in Zones A and B of domestic activity. The features and artifacts from both zones suggest activities related to the procurement and preparation of calcite or lime. Although no coca leaves were found at this site, similar pieces of burned and unburned lime and coca leaves were recovered from house floors at residential sites of the Las Pircas and Tierra Blanca phases, suggesting that the lime was produced for use with coca.

The two mounds at Nanchoc are some of the earliest examples in the Andes of formally organized and permanently marked public places and spaces maintained by increasingly sedentary people (cf. Moore 1996). The Nanchoc mounds make it clear that the tradition of mound-building started well before the larger and much better known structures of the late Preceramic period in Peru. Although a special place for the production of lime, the mounds also are unique in terms of their isolation from residential sites in the Nanchoc Valley. Local residents scattered around the valley and perhaps beyond probably gathered there periodically for lime production and for communal ritual. The latter function is suggested by the stepped mound forms themselves and the presence of rock crystals in them. (Rock crystals are usually associated with *curanderos*, or medicinal personnel, and sacred activities [see Rossen 1991: 599].) In addition to preparing lime, people could also have taken part in commonplace activities that were also essential social interactions such as arranging and reinforcing kin ties, establishing exchange relationships, and forging intergroup networks. The mere presence of the mounds – local landmarks built through sustained collective effort – also may have been enough to draw people back to a traditional meeting place imbued with social and perhaps sacred significance. A sense of community was underscored by the combined work of generations of people to produce the lime at a place that was spatially and functionally coherent and had a different and visible site plan.

Last, dual architecture indicative of a possible moiety-like social structure and/or an asymmetrical political organization in the Andes may have its earliest known beginning at the Cementerio de Nanchoc site. Not known is whether the two Nanchoc mounds were built and used simultaneously or sequentially (Netherly and Dillehay, 1986b; see Dillehay 2004), used exclusively by local communities or shared with distant populations, or served as only a public place for the production of lime. The meaning of dualism in this context also is not clear, though it appears to be related to intra- or inter-community social and economic production and possibly the staging of sequentially defined public activities. Also not understood is the extent to which this site was associated with sacred or ritual activities,

although its spatial isolation and its association with rock crystals suggest a special place and meaning within the society. Although other middle Preceramic mounds and special places exist in the Andes (e.g., Aldenderfer 1988, 1991; Moore 1996), not all of them are dual in nature and identified with a specific function such as the lime production. (A Preceramic site at Viru in the middle Zaña Valley also has two mounds but they have not been excavated and thus little is known of their chronology and nature. Dual mounds also occur at PV-10–13, Macauco I, and PV-19–15, Chical 1 and 2, in the middle Zaña Valley. The deepest levels of one mound at Macauco is dated at 7555–5794 BP [Beta 4243].) Undated Preceramic mounds also exist in Carahuasi in the upper Chamán Valley (Netherly and Dillehay 1985). They too seem to signal the separation between private and public spaces and presumably between individual households, if not a single dispersed community, and multi-households and closely tied neighboring communities.

THE TERMINAL PRECERAMIC PERIOD AT THE HILLSIDE SITE OF CERRO GUITARRA (PV-19–54)

As is evidenced throughout this volume, the authors believe that they understand the cultural dynamics of change during the Las Pircas and Tierra Blanca phases, particularly the downward thrust of settlement patterns toward the lower and particularly the middle valley floor. That is, small homesteads in the upper reaches of the lateral quebradas and alluvial fans gradually were located lower in the quebradas on their eventual move toward clearing and settling the main valley floor where more extensive and richer fertile soils for agriculture were located. There probably was a growing tension between the desire to expand restricted garden plots in the side canyons and small alluvial fans and concern with any negative aspects of the main valley floor, particularly its dense vegetation and possibly diseases (e.g., Dillehay 1991b; Gade 1979). In the upper and middle valley, the negative factors of clearing, burning, and occupying the valley floor were evidently overcome by the need for larger agricultural fields by the terminal Preceramic or Initial Period, as evidenced by the location of sites of these later periods in the middle valley (see Chapters 6 and 13).

During the early 1990s, the authors began to concentrate on investigating the terminal Preceramic occupations in the lower Zaña and Jequetepeque valleys. Surveys and test excavations at sites such as La Bocana at the mouth of the nearby Chamán River demonstrated that the Zaña and Jequetepeque valleys contain little evidence of coastal Preceramic

populations on the low-lying terraces or beachheads, formations that apparently did not stabilize until sometime after 8000–6500 BP. To date, only four Preceramic sites have been defined along the coast of the study area: PV-19–23 located south of Cherrepe and north of the delta of the Chamán River and radiocarbon dated to ~7000 +/− 100 BP (Beta-40633); PV-20–60 located near the delta of the Chamán River and dated ~7200 +/− 60 BP (Beta-39457); PV-19–24, a thin shell midden, located on the east side of the Purulén hills in the mouth of the Zaña Valley and undated; and an unnumbered Preceramic midden located on the southwest side of the Puemape hills near the shoreline. There are instead many small rural Formative, Moche, and Chimu sites along the coastal beach terraces that in some cases mimic Preceramic sites with their surface shell scatters but, based on the inspection of deposits in looter holes and upon a few of the test pits, do not contain earlier occupations. That is, the Preceramic sites of the north-central Peruvian coast, most spectacularly expressed at sites such as Huaca Prieta and other localities situated adjacent to coastal wetlands in the Chicama Valley, are very infrequent in the Zaña and Jequetepeque Valleys.

But a different type of Preceramic population was present in the lower valleys. A series of late Preceramic sites on the coastal plains and coastal hill ranges were found between 1992 and 2005 and classified as indeterminate localities due to the paucity of diagnostic lithics, including a few early Initial Period ceramics, and the lack of radiocarbon dates (see Chapter 12). Several of these sites have small semi-rectangular to rectangular domestic structures and appear to date to the terminal Tierra Blanca phase or early Initial Period (see Fig. 6.1). Smaller settlements are located on terrace crests or alluvial fans where now-dry riverbeds converge, while larger settlements are entrenched in wind-protected hillsides in places like the Q. del Examen, Q. del Batán, Q. Talambo, and others. The most notable site among all of these is Cerro Guitarra, a hillside village.

Cerro Guitarra

The best preserved and most complex hillside site in the study area is Cerro Guitarra. This is a prominent series of peaks that are visible from the Panamerican Highway 14 km east of the coast. The largest peak of Cerro Guitarra contains a Lambayeque/Chimu/Inca fortress, long known as one of the largest fortified sites on the north coast of Peru. Its high concentric walls and turrets are visible for kilometers, and several hundred rooms are associated with this late occupation. The site probably was positioned

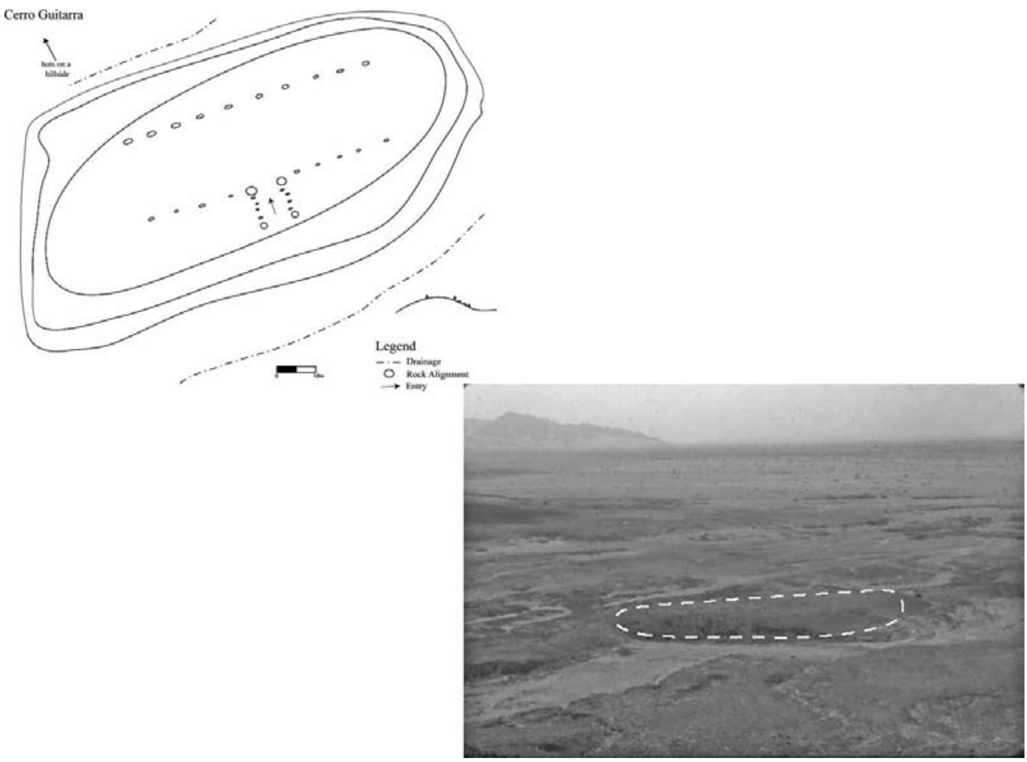


Figure 7.11. Plan and view of Zone B, public space, at the Cerro Guitarra site.

to control the coastal passage between hill ranges, and most of the later ceramic occupations had a westerly aspect that faces the prevailing wind. Three hundred meters behind the fortress on a lower peak with a wind-protected easterly aspect is the Preceramic hillside settlement of Cerro Guitarra. A dry riverbed hugs the base of the hill, and a flat terrace remnant lies on the opposite side of the river (Fig. 7.11).

The Preceramic site is an integrated village including shallow pit houses and a nearby public zone. The domestic structures are easily visible on the surface (Figs. 7.12 and 7.13). Houses are present in clusters of six to ten, and these clusters are interconnected by paths and by five stairways that are both cut into and built out of the steep hillside. A total of seventy-nine houses was mapped on three levels of the hillside. Some areas of the hill are buried or eroded by rockslides, and thus the original site probably had more houses. Four house clusters are located along the gently sloping hill base. One of these clusters is 150 m distant from the others, but it is connected to other house clusters by a pathway and to the hill summit by a stone-lined stairway. The lower houses are all semi-subterranean with double elliptical or figure-eight forms. Three clusters are located on the steep mid-slope area, where the houses are usually semi-subterranean

Figure 7.12. View of circular house structures on hillside of Cerro Guitarra.

or, in a few cases, circular with stone foundations and an accompanying windbreak. Many of these houses in the middle and lower levels display clear, lunar-shaped lithic concentrations along the lips of the house basins (Fig. 7.14). Houses on the steep hillside have vertical retaining slabs to stabilize the inclined hillside. On the hill summit, eleven structures are present, including several large agglutinated rooms. These are all elliptical

Figure 7.13. View of circular house structure on summit at Cerro Guitarra.

Figure 7.14. Shows concentration of lithic debris in and around house structure at Cerro Guitarra.

and circular stone foundations, and the entire summit is protected by a large stone windbreak. These houses vary in size based on their location within the site. Low-lying circular pit houses range from 1 to 2 m in diameter, mid-slope houses are 1.5 to 2.5 m in length, and rectangular structures on the hilltop average 4 m long and 2 m in width.

The hillside of Cerro Guitarra is dotted with quarrying activity. Large quarried boulders and deposits of primary chipped material, including basalt, andesite, and quartzite, are concentrated along the lower and middle slope areas. The site surface contains literally millions of primary flakes. Many refitted lithics and small workshop areas are directly in front of and outside house entrances. During surveys of the lower Zaña Valley, several other hillsides were documented that exhibit similar intensive quarrying activity. There were also other hillsides with similar semi-subterranean houses, but none had domestic areas as large as those in Cerro Guitarra. One such site is JE-734, located in the middle Jequetepeque Valley on an isolated terrace of a side canyon. It has twenty-two semi-subterranean circular houses and possibly belongs to the same time period and terminal Preceramic phase (Dillehay et al. 2009: 307).

Down in front of the Cerro Guitarra site and house clusters, a short distance across a narrow dry creek bed, is an island-like terrace remnant. This terrace contains a public plaza area, with two parallel lines of stones and intermittent pairs of vertically placed boulders marking corners and

segments at approximately 40 m intervals along the lines (Figs. 7.11 and 7.15). Some stones have been removed and are represented by their setting holes. Removed stones are lying on the plaza surface with desert varnish on the formally exposed standing portion. The public area also contains stone-lined posts, smaller structures, and a stairway entrance facing the east. The entire plaza area measures 120 m by 25 m. An entrance and stairway to the plaza is evident. Also found on the surface were several flakes similar to those recovered from structures and quarry sites on the nearby hillside.

Figure 7.15. Remnant line of standing stones marking the public space at Cerro Guitarra.

After investigating whether Cerro Guitarra represented an amalgamation of different Preceramic occupations, the authors became convinced that despite the often far-flung house clusters and the variation in domestic architecture, the entire 250,000 square meter site represents one integrated occupation. Aside from the pathways and stairways crossing the site, the house clusters at all levels form an amphitheater-like semicircle around the low-lying public zone. The plaza is visible from seventy-seven of the seventy-nine known houses at the site. The similarities of house form and lithics also unite the site as a single occupation.

Twelve houses were excavated during the 1997 field season (Rossen 1997). All have internal partitions similar to those of the Tierra Blanca phase, but in this case they are circular rather than rectangular. In three houses, a second room was filled with large basalt cores. These houses contain up to 80 cm of ashy deposits, while most of the site surface contains no subsurface deposits. The basal houses in particular were repeatedly rebuilt, producing partial and juxtaposed subterranean walls and low rings of accumulated backdirt. The stratigraphy reveals that these houses were occupied seasonally, probably during the (November to April) dry season, and abandoned during the (May to October) humid, winter season. The rains from each season of abandonment produced a compacted colluvial surface a few millimeters thick with resulting culturally sterile deposits

and a lamination effect. As many as 200 laminations or reoccupations of individual houses were recorded (Fig. 7.16) indicating intermittent and seasonal occupation.

The circular stone houses at the hill summit were not partitioned. The summit houses were heavily wind-deflated and have virtually no deposits. Ground stone bowls lay on the original house floor. An exception is one of the most distinctive houses (# 45) of the summit. The house is perched on the sheer edge within a niche of hillside rock; excavation exposed two steps down into an L-shaped room and a hearth niche with wood charcoal.

The pit houses with internal deposits contain lithics and ground stone. No ceramics were found at the site. The lithic industry is unifacial, like most lithics in the Zaña Valley. The Cerro Guitarra lithics, however, are larger, more crudely made, and more expedient than those of the Nanchoc Lithic Tradition, associated upvalley with the Las Pircas phase (see Chapters 5, 11), or even the less formal lithics of the Tierra Blanca phase. There is abundant, immediately available raw material at Cerro Guitarra, and probably for that reason no formal tool types are present. This underscores a key point made throughout this volume – that throughout the Andes and even within the Zaña Valley itself, Preceramic unifacial industries, often based on plant processing and woodworking activities, are greatly varied and defy being lumped together. In contrast, the abundant ground stone industry, mostly flat slab *batanes* and hand *manos*, is fairly typical of Preceramic ground stone throughout the valley.

Plant remains were recovered from a few houses with midden deposits. House 45, at the edge of the summit, contained the best-preserved plant materials. Identified were cotton (*Gossypium barbadense*), squash (*Cucurbita* sp.), and peanuts (*Arachis* sp.). Maize (*Zea mays*) is present in several site contexts in a primitive, eight-row form, probably representing its first appearance in the valley. A dry creek bed east of the site contains elevated areas with smeared nondiagnostic surface features and Cerro Guitarra–style unifacial lithics that appear to represent agricultural fields.

It is becoming increasingly clear that during the Preceramic period of the study area, different combinations of plants were cultivated at different locations at different times, even within individual valleys, and thus plant cultivation and domestication occurred in a mosaic pattern of spatially and temporally specific patterns of experimentation and adoption (see Chapter 9). It is therefore probably futile to search for patterns of earlier and subsequent pan-Andean suites of domesticated plants. Wild plants recovered at Cerro Guitarra include *algarrobo* (*Prosopis chilensis*) pods, plum or *ciruela* (*Bunchosia* sp.), and columnar cactus fibers.

Figure 7.16. View of laminated stratigraphy in house at Cerro Guitarra showing cycles of occupation and abandonment.

A faunal assemblage includes lizard (*Dicrodon* sp.) and brocket deer (*Mazama* sp.). Only a few examples of shellfish (*Donax* sp.) were recovered. The small size of the faunal and shell assemblage and the absence of fish bone may be due in part to preservation or depositional issues, because middens are not present outside of house deposits. However, if there was a maritime subsistence focus at this site, located 14 km from the present-day coastline, there should be large amounts of shell scattered across the site surface. It thus appears that subsistence was based on agriculture, snaring, trapping, and hunting.

Three radiocarbon dates from Cerro Guitarra include an AMS date from House 73 of 3867–3481 BP (GX-25033-LS). A matching pair of charcoal and shell samples from a depth of 36 cm in House 45 produced dates of 2919–2721 BP (CAMS46613) on charcoal and 1650–1410 BP (CAMS46614) on *Donax* shell. This pair of dates was performed as part of a research project conducted at Lawrence Livermore National Laboratory investigating error associated with dates taken on shell. The first two dates appear to be a reasonable bracket for the occupation at Cerro Guitarra. Calibrating these dates leads to a range for the site of 3835 to 2867 BP. This represents a terminal Preceramic or more likely an *aceramic* occupation for this site. There were similar late dates on two Preceramic sites in the lower Jequetepeque Valley, JE-971, a long-term, repeat field camp, and JE-393 (Stackelbeck 2008: 439–442). Given that Preceramic sites in the middle

and upper Zaña Valley at La Toma and Macuaco were also occupied in the terminal Preceramic and early ceramic periods, places like Cerro Guitarra may represent a survival of the Preceramic lifeway that had already disappeared upvalley in the Nanchoc area.

Along with the late absence of ceramics, the lack of exotic materials and the crudeness of the unifacial lithics suggest a provincial group residing at Cerro Guitarra. It is known that during the Las Pircas phase, upvalley populations were at least sporadically linked to their coastal counterparts, and that during the later Tierra Blanca phase, social and exchange networks appear to have disintegrated upvalley. The locally focused Cerro Guitarra group may thus represent one of the downvalley results of this devolved period of social isolation and an isolated example of complexity at a specialized site.

Preceramic Hillside Settlements: Chronology and Comparisons

During excavation of the site, the architecture and site layout suggested a terminal Preceramic or aceramic date for Cerro Guitarra. The separate positioning of the public plaza below and in front of the domestic zones suggests an early form of hillside settlement, when access to the public area was visible to all and relatively unrestricted and egalitarian. The Zaña and Nanchoc valleys also have a pattern of separated public space and dual mounds, as is manifest at the Cementerio de Nanchoc site (CA-09–04) and the small habitation sites located across the valley floor; the Chical I, Macauco I-II, and Viru sites in the middle Zaña Valley; and the Carahuasi mounds in the upper middle Chamán Valley. However, in the case of Cerro Guitarra, the separation of public and private space is maintained within a single integrated site. Further, it is likely that the occupants at Cerro Guitarra interacted with various terminal and early ceramic settlements present in the nearby quebradas of the lower valleys.

Large Preceramic hillside sites in other valleys like Culebras near the Casma Valley and Puerto Santa in the Santa Valley have public areas on the hill summit (personal observation, 1992), implying restricted access and perhaps better developed social hierarchies. These two sites are quite large, with hundreds of pit houses and walls at the hill base demarcating the settlement zone. The Formative site of Puerto Etén, near the coast in the Lambayeque Valley, also includes a Preceramic hillside component (Dillehay and Eling 1989). Cerro Guitarra represents a somewhat different form of Preceramic hillside settlement, with an aggregated configuration

bounded only by a creek bed and its public sector located below (instead of above) the domestic zone.

Various forms of hillside sites should be recognized as another settlement strategy of the late Preceramic period in the lower portions of the northern Peruvian coastal valleys. Cerro Guitarra represents a more spatially integrated community and a more protected if not defensive settlement position than earlier dispersed alluvial fan sites. It is possible that at some point during the late Preceramic period when people were moving downvalley to access more fertile and expansive agricultural lands, social conflict might have led to increased defense of hillsides, including walls and a shift of the public sector from down in front of the domestic zones to hill summits. Perhaps the long-time research emphasis on the low-lying riverine terraces near the present-day coastline has prevented recognition of the significance of other localities and site types such as the alluvial fan and hillside settlement patterns characteristic of the interior coastal plains and hills.

DISCUSSION

Cerro Guitarra imparts an image of a distinctive coastal hillside population at the terminal stage of the Preceramic, with little image of any unified valleywide cultural system. At the close of the Preceramic, some populations in the lower Zaña Valley apparently operated on a seasonal settlement system of aggregation and dispersal, as opposed to the local permanence that was long established among earlier upvalley groups. Lower valley peoples also had a localized resource focus, whether it be marine or agricultural foods, in sharp contrast with the more cosmopolitan multiple ecozone exploitation patterns and social networks of the earlier upvalley groups of the Nanchoc basin.

Much of the story of this volume on Preceramic northwest Peru involves understanding why certain aspects of culture developed and advanced ahead of others in particular times and places. The enigma of Cerro Guitarra is the development of an intermittently used but integrated community organization, including at least seventy-nine houses and a public plaza, alongside an apparent absence of outside social and exchange contacts. The absence of exotic materials continues a pattern previously established during the Tierra Blanca phase. In general, Cerro Guitarra represents a distinctive type of terminal Preceramic population. It is not the classic coastal maritime Preceramic site in the image promoted by aggregated

communities like Huaca Prieta and Pulpar in the Chicama Valley. In some respects, the Cerro Guitarra village represents the virtual antithesis of the middle and upper Zaña and Nanchoc Preceramic populations, who were technologically more sophisticated and more locally permanent, but less aggregated with a dispersed pseudo-dense settlement pattern. One common thread up and down the Zaña and Nanchoc valleys is that, from the late Las Pircas phase on, each group in different ways sought a level of community integration that focused on the demarcation and use of public space.

Cerro Guitarra also appears to represent the terminal end or ultimate manifestation of the Preceramic lifeway in the Zaña Valley. Based on this site and others in the study area, two main processes dominated culture change as this lifeway disappeared. The first is the acceleration of population rise and agricultural production. The closer integration of public and private space and the more extensive and tighter spatial aggregation of houses at Cerro Guitarra and the nearby elevated agricultural fields may represent the beginnings of this process. The second, of course, is the introduction of ceramics at other sites in the study area at about this same time (e.g., La Toma and other Initial Period sites: Tellenbach 1985), with all the social institutions of material procurement, craft specialization, and the use of this elastic medium for the conveyance of social and political ideas. These two and other processes led to the exponential population aggregation and large-scale monumentalism that is represented locally at Initial Period sites like Purulén in the lower Zaña Valley (Alva Alva 1988) and San Luís in the middle valley (Dillehay 2004). In this post-Cerro Guitarra transition, the Zaña Valley probably fell under the cultural and political influence of larger valleys such as the Lambayeque Valley to the north and the Jequetepeque to the south.

To conclude, Preceramic populations in northern coastal valleys like the Zaña Valley experienced some of the most fundamental transitions of human history. Those are semisedentism, communal works, new and multiple household economies, and public ritual, to name a few aspects of change and development. Within this broad pattern, it is clear that there was more variability in late Preceramic settlement and subsistence than was previously suspected. This variation existed in terms of topographic location of settlements, site size, degree of house aggregation, individual house size and shape, types of public space (plazas, mounds, canals), technology (particularly, different unifacial industries), and subsistence economy, including distinctive cultigen combinations at different locales at different times. Settlement shifts such as the lower valley coalescence

of hillside aggregated villages were an important aspect of this complex of developments. There is no reason to explain these shifts exclusively in terms of a rising or aggregating population, demographic pressure, or climate change.

Our evidence throughout the Zaña Valley suggests that people were locally permanent (sometimes even within an aggregation-dispersion pattern) and chose to live in certain aggregated areas, leaving other resource-rich, suitable areas unoccupied, such as parts of the coastline and upvalley vegetated quebradas. Particularly significant is the development of communal public identities on a relatively small scale, as locally indicated throughout the Zaña and Nanchoc Valley by several sites such as the Cementerio de Nanchoc and Cerro Guitarra as well as elsewhere at sites like Puerto Etén, Puerto Santa, and Culebras in coastal Peru and Real Alto and other Valdivia culture sites in southwest Ecuador. It appears that the factors sustaining later ideological, technological, and subsistence developments in the Central Andes are direct extensions of the processes that occurred at these sites, which are evident but not yet dominant or even materially conspicuous during Preceramic times.

CHAPTER EIGHT

Human Remains

John W. Verano and Jack Rossen

This chapter discusses the human skeletal remains recovered from sites CA-09–27, CA-09–28, CA-09–52, CA-09–71, CA-09–73, and CA-09–77 in the upper Zaña Valley, Peru. These sites are all located in the Nanchoc section of the valley. The first three sites date to the Las Pircas phase, while the last three sites are affiliated with the Tierra Blanca phase. One Las Pircas phase site (CA-09–27), with its elliptical house, storage unit, and garden area, contained only a single hyoid bone, an element infrequently recovered archaeologically due to its small size and fragile nature, and one tooth. A nearby Las Pircas phase site, CA-09–28, contained one primary, articulated flexed burial of a single individual, and four human bone clusters, including several burials of partial single individuals. This site also contained human bone scattered throughout the site midden, but no houses or furrowed gardens were located through excavation. Site CA-09–28 contained 857 small human bone fragments scattered throughout the midden, for an average of 31.7 fragments per 1 m^2 unit (Rossen 1991: 582). The third Las Pircas phase site with human remains is CA-09–52, with a single complete but highly fragmented individual placed in a circular pit. This site primarily contained furrowed areas interpreted as gardens, but no houses. This site also exhibited a lower density of human bone fragments, 7.9 fragments per one m^2 unit of human bone fragments, scattered through the midden. One site, CA-09–77, from the subsequent Tierra Blanca phase, produced hundreds of highly fragmented, disarticulated human remains found commingled with faunal remains in compact floor fill. Some of these bones show cut marks and burning, suggesting that both the faunal and human remains on the house floor may reflect the end result of butchery and consumption. Two sites, CA-09–71 and CA-09–73, yielded a few heavily fragmented human bone remains from a house floor. In contrast, the human remains of the Las Pircas phase are not commingled; they are

cut, mutilated, and/or placed in shallow pits or they are articulated burials located outside of the houses. Earlier human remains were recovered from a terminal Pleistocene to early Holocene site in the Q. del Batán, but they were so fragmentary that little more can be said about them (Maggard 2010).

EL PALTO PHASE

Human remains are rare in late Pleistocene to early Holocene archaeological contexts (Dillehay 1997b). However, primary interments, secondary burials, and/or disarticulated skeletal elements have been documented on both early and middle Preceramic sites in the north coast region (Chauchat 1982, 1988; Chauchat et al. 2006; Dillehay 2000a,b; Dillehay et al. 1997; Ossa and Moseley 1972; Rossen 1991). Among the 126 El Palto phase sites in the Q. del Batán, only one site (JE-1002) yielded human remains. The human remains encountered at this site consisted of a heavily disturbed and disarticulated burial eroding on the site surface. It is estimated that only 30 to 35 percent of skeletal elements of an individual were present. Identifiable elements included two femurs, illium fragments, and lumbar vertebrae, along with numerous, small unidentified fragments. Given the context and disturbance, little information can be said regarding this burial. However, given the nearby association of Paiján lithic tools and a circular domestic structure, it is likely that the burial relates to the Paiján (probably late Paiján) occupation of the site.

LAS PIRCAS PHASE

Examination of the human remains from the Las Pircas phase sites in the Nanchoc area was conducted by Guillén (1988). In these sites, the human bones are spatially segregated from the midden areas that contain faunal remains and domestic debris. In particular, site CA-09–28 appears to be a special mortuary activity area. Most notable in the Las Pircas phase remains is the observation of missing ends of many of the long and short tubular bones. Longbones are broken at either the midpoint or the epiphysis. The abrupt and clean edges led the excavating archaeologists to believe that these portions of the bones were intentionally cut or broken off prehistorically. Some bones have angled breaks that suggest they were partially cut and then snapped (Dillehay et al. 1989; Rossen 1991; Rossen and Dillehay 2001b).

Figure 8.1. Articulated human skeleton from site CA-09–28.

While Guillén did not find cut marks at the bone margins, she reported that the "abruptness" of the breaks suggested "intentionality" (Guillén 1988: 17). She noted that the clean nature of the breaks suggests that the bone was cut while fresh and that it does not contain splintering or irregularities that would suggest the breaking of dry bone of secondary burials.

The possibility of breakage due to post-depositional disturbance or fluvial action was considered but rejected. A study of the orientation of broken bones at the site revealed that while some bones were oriented in the downslope direction, many others were oriented perpendicular and diagonal to downslope. Fluvial action thus could not explain the orientations of the bone clusters. Also CA-09–28 contains a single, intact flexed burial. This is an adult male in a flexed position on his right side facing west (Fig. 8.1). All portions of this articulated skeleton are represented,

including some relatively small and fragile bones. This burial was covered by a rock pavement and was situated in a depression in the midden on top of sterile subsoil. The stratigraphy and characteristics of the midden surrounding this intact burial are identical to those in the fragmented bone areas of the same site.

Site CA-09–52 contained little human bone in the midden. One highly fragmented burial was recovered, the remains of a complete adult male with extreme tooth wear. The teeth show striations that are evidence of advanced periodontal disease (Guillén 1988: 18). All bones except the cranium are broken into pieces with an average length of 5 cm and placed within a 30 cm diameter pit. The cranium was broken into two pieces. In the midden of CA-09–52, three fragmented arches of cervical vertebrae of a newborn infant were recovered. These are the only recovered human remains from the Las Pircas phase sites that are not from sub-adult or adult males, and they were the only human bones recovered from the central block of the site. The spatial segregation of the infant remains implies a different context from that of the adult remains. Perhaps infants were somehow unsuitable for the specialized treatment accorded to male sub-adult and adult remains.

Guillén made some comments on diet and health indicators of the human remains from the Las Pircas phase sites. She stated that all the teeth exhibit advanced wear from incisors to molars, and that this "abrasive wear . . . resulted not from the material consumed as in the case of shellfish eaters who consume large quantities of sand, but from a mechanical stress, probably from chewing tough plant materials. It can be deduced that the diet was adequate. There is no evidence of cavities, and much dentition was intact at the time of death" (Guillén 1988: 2).

TIERRA BLANCA PHASE

Skeletal material from the Tierra Blanca phase sites near Nanchoc was examined by the first author. As a first step in the analysis, general data were collected on fragment size, condition, and surface characteristics of the bones. Careful examination then was made for cut marks, burning, or other signs of human or animal modification. Bones were identified where possible to element, side, and section. Isolated teeth and tooth and root fragments were identified as specifically as possible, and observations were made on occlusal wear and any evidence of caries, abscesses, or other pathology.

The Tierra Blanca human skeletal material is highly fragmented. In the examined samples, fragment size ranged from 10 × 10 mm up to 75 mm in maximum dimension (maximum length of a femoral shaft fragment), although most fragments averaged approximately 20–35 mm in maximum dimension (Fig. 8.2). The surfaces of most bones are eroded, although there is good cortex preservation on some specimens (Fig. 8.3). Most of the breakage of the material is clearly prehistoric, as evidenced by a lack of color differences between fractured and intact surfaces, although there is recent breakage as well.

Figure 8.2. Photograph of one of the boxes of skeletal material recovered from hardened cement-like floors in Tierra Blanca phase site CA-09–77, showing fragment size variation. (White broken fractures are fresh breaks resulting from chiseling bone from the hard floors.)

Element Representation

In the Tierra Blanca phase assemblage, most common are long bone shaft fragments and unidentifiable postcranial fragments. Shaft fragments were ubiquitous in this assemblage and were so numerous that a total count was not attempted. Table 8.1 lists, by site, counts of elements that could be specifically identified for all Las Pircas and Tierra Blanca sites (i.e., vertebrae: Fig. 8.4). It incorporates both the first author's observations and those of Guillén. With regard to fragmented remains, the most frequently identified identifiable elements were cranial vault fragments (representing portions of the frontal, parietal, or occipital bones), ribs, and hand and foot bones. The high counts for these elements probably reflect, at least in part, the relative ease with which they can be identified visually. For example, small

Figure 8.3. Bone fragments with relatively good cortex preservation.

Table 8.1. Identified Disarticulated Elements by Selected Site Number[a]

Element	CA-09-27	CA-09-28	CA-09-52	CA-09-77	Totals
Skull Vault	1	59	19	150	229
Parietal		2			2
Occipital		3		1	4
Temporal		1	1	1	3
Mandible	3	3		4	10
Hyoid	1				1
Cervical Vertebrae		2	4		6
Thoracic Vertebrae		1	2		3
Ribs	2	23	14	1	40
Os Coxae		1			1
Scapula		1			1
Clavicle		5	5	1	11
Humerus	1	8	4	6	19
Radius	1	6	1		8
Ulna		2	8	3	13
Carpals	1	5	2		8
Metacarpals	3	9	3	1	16
Hand Phalanges		6	17	1	24
Femur		5	4	2	11
Tibia	1	3	1	1	6
Fibula		6	1		7
Tarsals		4		3	7
Metatarsals	1	4	7	4	16
Foot Phalanges	2				2

[a] Since only three unidentified bone fragments were recovered from the house floor at site CA-09-71, they are not listed above.

fragments of ribs and cranial vault bones were readily recognizable due to their distinctive morphology. In contrast, it was difficult to specifically identify and distinguish femur, tibia, and humerus, or radius, ulna, and fibula from small shaft fragments. As a result, these bones are underrepresented in Table 8.1.

Dental Remains

A total of ninety-one isolated teeth, tooth crowns, and roots were identified in the total Tierra Blanca phase collection. These included twenty-six whole teeth, twenty-one tooth crowns, and forty-four roots and root fragments (Table 8.2). All of the dental remains were of permanent teeth, except for two deciduous lower molars and a deciduous lower canine recovered from two excavation units at site CA-09–77. Most tooth crowns showed heavy wear, with dentin exposure over most of the occlusal surfaces, pronounced

reduction in crown height, and in some cases, exposure of the root canal as a result of advanced wear. Incisors showed a distinct pattern of angular wear (Fig. 8.5), which Guillén suggested might reflect the processing and consumption of tough plant foods (Guillén 1988). No caries were observed on any of the tooth surfaces, similar to the observation made by Guillén for the Las Pircas phase. This, along with the evidence of heavy wear, suggests an abrasive diet low in carbohydrates or a diet of hard plants with carbohydrates.

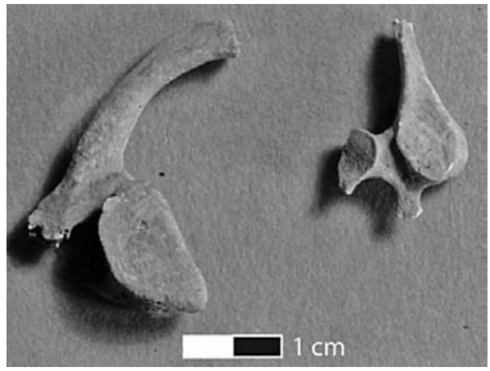


Figure 8.4. Arches of two cervical vertebrae from an infant (CA-09–52).

Age, Sex, Number of Individuals

Both adults and subadults are present in the Las Pircas and Tierra Blanca bone assemblage. Adult age and sex could not be reliably estimated due to the fragmentary and mixed nature of the material. On the basis of general size and morphology, however, it is judged that almost all human bone recovered from the Las Pircas phase is male. For the Tierra Blanca phase, one mandible fragment and five postcranial fragments are female, and one mandible fragment, a partial occipital bone, and three humerus fragments are male. Both Guillén and the first author noted relatively advanced stages of dental wear on most permanent teeth, although without correlative skeletal age indicators for this population, it would be problematic to use dental wear to estimate age at death. The presence of subadults in the assemblage, however, is clearly indicated by three deciduous teeth found at site CA-09–77 (Table 8.2), several vertebral arches and a hand phalanx of an infant, and portions of a left humerus and ulna of a child approximately 3–5 years old at site CA-09–52, as well as subadult cranial and postcranial fragments noted by Guillén from sites CA-09–27 and CA-09–28 (Table 8.3). As stated above, the complete fragmented adult from Site CA-09–52

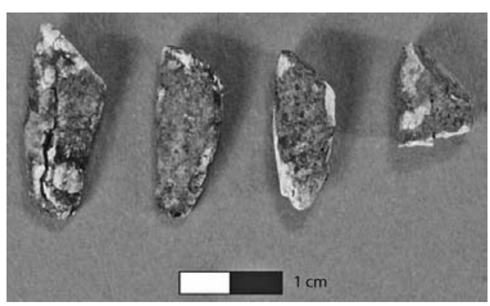


Figure 8.5. Incisor teeth with angular wear (CA-09–77).

Table 8.2. Dental Remains from Selected Sites[a]

Site	PZ	Unit	Level	Roots	Crowns	Whole teeth	Upper permanent	Lower permanent	Upper deciduous	Lower deciduous
CA-09-27		S1 W70	1			1		R Canine		
CA-09-28		N0E0	3			1	?Premolar			
		N0E0	3			2	L Incisor	?Molar		
		N0E0	4			1	Incisor			
		N0W1	5			3				
CA-09-52		N10W6	2			1		L I1		
		N15W3	1		1		I1			
		N15W4	1		1		R I2			
		N15W4	3	1						
		N15W4	3			1		C		
		N15W5	3			1	R I1			
		N15W5	4			1	M2			
		N15W5	2			1	M1			
		S12W7	2			1		M1/M2		
CA-09-77	1	S1 × 1	2	1						
	2	N1 × 1	3	7	6	1	M3, M2, M?,M?	I2, M3, C		
	2	N1 × 1	3	10	7		M3, PM, PM	I2, M3, C		dm2
	3	E1 × 1	2	4						
	3	E1 × 1	4	14	3	5	M3, M3, M3	C, I1, I1		dm2, dc
	4	E1 × 1	3			4	I,I,C,C			
	4	W1 × 1	2	1						
	4	W1 × 1	3	3	1			M3		
	5	N1 × 1	2	1	1	1	LM2	M3		
	6	S1 × 1	2		1		PM			

[a] No dental remains were recovered from site CA-09-71.

Table 8.3. Subadult Bones from Sites CA–09–27, CA–09–28, and CA–09–52

Site	Unit	Level	Observer	Element	Side
CA-09–27	N1E1	4	SG	Radius	1
CA-09–27	N1E1	4	SG	Humerus	I
CA-09–27	N1E1	4	SG	Tibia	I
CA-09–28	N0E2	5	SG	Scapula	I
CA-09–28	N0S4	1	SG	Vault Fragment	I
CA-09–28	S1E1	2	SG	Vault Fragment	I
CA-09–52	N0W1	3	JV	Clavicle	R
CA-09–52	N10W6	2	JV	Vertebra	I
CA-09–52	N15W4	4	JV	Metacarpal	I
CA-09–52	N9W5	1	JV	Cervical Vertebra	I
CA-09–52	N9W6	4	JV	Cervical Vertebra**	L
CA-09–52	N9W6	4	JV	Atlas**	R
CA-09–52	S10W7	6	JV	Epiphysis*	I
CA-09–52	S10W7	6	JV	Ulna*	L
CA-09–52	S10W7	6	JV	Humerus*	I
CA-09–52	S11W8	2	JV	Hand Phalanx	I
CA-09–52	S11W8	6	SG	Hand Phalanx	I

The humerus, ulna, and epiphysis marked with * appear to be from a single individual. The two vertebrae marked with ** also appear to be from a single individual. Codes for Side: L = left, R = right, I = indeterminate or not recorded.

was a male of advanced age. A confident estimate of the total number of individuals represented in the Tierra Blanca bone assemblages is not possible, given the highly fragmented and commingled nature of the material, although it is clear that subadults and probably adults of both sexes are present.

Taphonomic Observations

Cut marks were observed on only two bones out of the total sample examined from the Tierra Blanca sites. Both were on long bone shaft fragments that were consistent in morphology and density with human bone, although identification is provisional given their fragmentary nature. In evaluating evidence of bone modification in the Tierra Blanca sample, it must be emphasized that most bone surfaces were poorly preserved, greatly limiting observations on cut marks or other surface features. In the two observed cases, however, they were clearly the result of intentional human activity. The marks are V-shaped channels that appear to have been produced by repeated grooving with a sharp object (Figs. 8.6 and 8.7). Their morphology does not suggest that they are the result of activities related to defleshing or dismemberment – they more closely resemble the kind of cutting and grooving representative of intentional

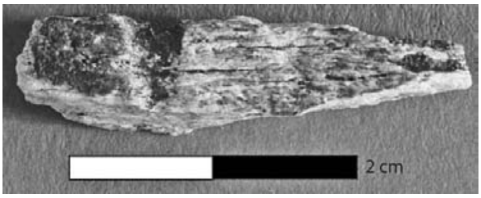


Figure 8.6. Long bone shaft fragment with cut.

bone modification, such as in the production of bone artifacts and ritual objects, although none were found archaeologically.

Many of the Tierra Blanca phase bones show evidence of having been burned. Burned bone could be recognized by a porcelain-like "ring" of fragments upon contact with hard surfaces, and by a bluish-gray color of bone cortex exposed by recent breaks (Fig. 8.8). No evidence of warping or curved cracks was seen, arguing against the cremation of fleshed remains (Stewart 1979; Symes et al. 2008; Ubelaker 1999). No patterning was identified with regard to which elements were burned or not burned, although none of the dental remains showed evidence of thermal damage.

THE QUESTION OF CANNIBALISM

During the Las Pircas phase, human bones were cleanly fragmented in areas and placed in small pits that were spatially segregated from domestic debris and houses and in one case at a special activity site. In the following Tierra Blanca phase, highly and irregularly fragmented, cut, and burned human remains were found commingled with faunal material in house floors (see Chapters 5 and 6). These patterns suggest the possibility of cannibalism (Rossen and Dillehay 2001b). To consider this possibility, it is appropriate to discuss other reports of isolated human bones found in what might be considered "nonmortuary" contexts at Andean archaeological sites. Isolated human bones are not an uncommon occurrence at sites with multiple or extended periods of occupation. In most cases, such findings have been interpreted as the result of the accidental disturbance of earlier burials by later occupants of the site (Bonavia 1982b: 397; Feldman 1980: 121–122; Shimada 1982, 1985; Strong and Evans 1952: 41). Cannibalism occasionally has been proposed to explain these occurrences, particularly in the case of human bones found in domestic refuse deposits (Fung 1969; Lumbreras 1989; Strong and Evans 1952: 41; Uhle 1925). Lumbreras has revived the cannibalism hypothesis

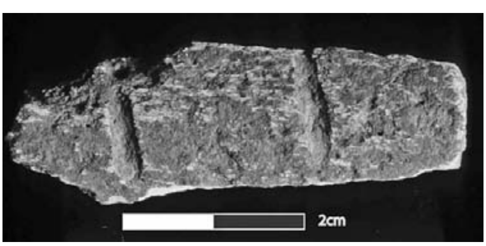


Figure 8.7. Long bone shaft fragment with two parallel cuts.

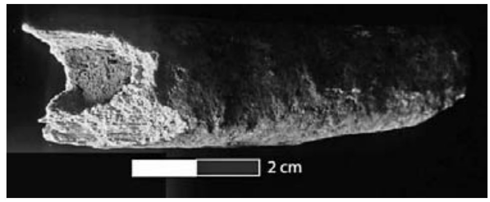


Figure 8.8. Long bone with recent fracture, revealing burning.

and stated that there is evidence of cannibalism at many Preceramic sites in Peru (Lumbreras 1989: 206–211). He does not present any specific data to support this assertion, such as evidence of perimortem fracture, cut marks, dismemberment, or burning. Without osteological evidence, claims such as these remain unsupported. Scholars who have made serious attempts to demonstrate (e.g., Turner 1983; Villa et al. 1986; White 1992) or refute (e.g., Dongoske et al. 2000; Marden 2009) cannibalism in the archaeological record have presented detailed criteria for testing such hypotheses. Any purported cases of cannibalism in Peru should be tested in a similarly rigorous fashion before conclusions are drawn about dietary practices in the Preceramic period.

Elsewhere in tropical America, archaeological evidence of disarticulated human remains has been documented. Three examples are worthy of mention because these sites have been compared to the Preceramic sites of the Zaña Valley in other ways, such as for having unifacial lithic industries in forested settings. The late Preceramic site of Aguazuque, Colombia, contained substantial cut and placed human bone reminiscent of the Las Pircas phase materials (Correal 1989: 146–154, 255–256). In Panama, at the Preceramic shell midden of Cerro Mangote, more than one-fourth of the excavated burials were disarticuled and cut (McGimsey and Collins 1986–1987). Also in Panama, the Aguadulce Shelter, a late Preceramic site, contained burned and cut human bones of both males and females. In this case, the investigators argued that a single incidence of cannibalism occurred as an act of survival by nutritionally stressed people (McGimsey and Collins 1986–1987: 4–6).

Evidence of cannibalism in the archaeological record remains controversial, but the most convincing arguments that certain human bone assemblages represent the end product of "conspecific consumption" (White 1992: 339) come from cases in which it can be demonstrated that there is a close similarity in the processing of human bones and faunal remains at the same site. Critical to such arguments is the identification of "patterned damage" to the skeleton consistent with defleshing and disarticulation, as well as additional activities such as marrow extraction and cooking. Evidence suggesting butchery and cannibalism has been reported by Villa and colleagues from Neolithic France (Villa et al. 1986), and by Turner

and colleagues (Turner 1983; Turner and Morris 1970; Turner and Turner 1998), White (White 1992), and others (Billman et al. 2000) from various sites in the southwestern United States. Patterns of bone damage recorded in these samples include perimortem percussion fractures, percussion pits, chop marks and abrasions on the skull and shafts of long bones (presumably related to brain and bone marrow extraction), patterns of cut marks consistent with muscle removal and joint dismemberment, and patterned burning on bones suggestive of roasting, with more intense thermal damage to bone surfaces relatively unprotected by overlying muscle tissue (White 1992: 201–206; Turner and Turner 1999). Importantly, comparisons with faunal material from these same sites, or related occupational sites, show similar patterns of cut marks and fracture damage.

Telltale signatures of defleshing, perimortem fracture, dismemberment, and marrow extraction, if once present on both the Las Pircas and Tierra Blanca bone material, are no longer observable due to the extensive erosion of bone surfaces and the degree of fragmentation of the remains. A substantial portion of the Tierra Blanca bones shows evidence of burning, but the material is too fragmented to allow inferences as to patterns of heat exposure. For example, one cannot rule out the possibility that the burning was unintentional, especially since the material was found on house floors with functioning hearths in Tierra Blanca sites. The few examples of cut marks visible on the Tierra Blanca bones do not appear to be consistent with defleshing or dismemberment. These bones show wide channels that appear to have been produced in a controlled manner by repeated grooving, and they do not resemble the typically shallow and narrow cut marks seen in defleshing or dismemberment (Hamilton 2005; Verano 1998, 2001, 2008).

A more ritualistic form of cannibalism, on the other hand, would not carry the expectation of similar treatment of human remains and faunal remains. In this sense, the treatment of human bones appears to have been more ritualized during the Las Pircas phase, when bones were more carefully fragmented and placed and spatially segregated from domestic activities, than during the Tierra Blanca phase, when bones were haphazardly broken, crushed, and commingled with faunal remains beneath house floors. If a more ritualized form of cannibalism is considered, the most suggestive evidence that cannibalism may have been practiced by the Preceramic occupants of the upper Zaña Valley comes from the Las Pircas phase contexts. The possible meaning of the shift between the two phases

in the treatment of human bone is further discussed in Chapters 5 and 6. Unfortunately, the relatively poor preservation of the skeletal material precludes the identification of systematic perimortem breakage, defleshing and dismemberment, patterned burning, or other key indicators that could confirm butchery and suggest consumption.

CHAPTER NINE

Preceramic Plant Gathering, Gardening, and Farming

Jack Rossen

This chapter discusses the Preceramic plant-use history of the Zaña, Jequetepeque, and Nanchoc valleys. The long-term accumulation of water flotation data throughout the valleys from El Palto, Las Pircas, Tierra Blanca, and terminal Preceramic phase sites has produced a fine-grained plant-use record that may be set against the culture history as produced by more traditional datasets. During the early Preceramic El Palto phase (11500–9800 BP), highly mobile groups used plants as reliable supplements to their hunting lifeways, with a strong coastal focus on *algarrobo* pods, cactus fruits, snails, and other wild foods. In the upper valley, the cultivation of squash began during this phase. The Las Pircas phase (9800–7800 BP) was a time of continued broad-spectrum plant collecting in much of the valley but also the local development of multiple plant cultivation and house gardening in selected areas such as the south bank of the Nanchoc River. Simple feeder ditch technologies may have begun during this time as well (Dillehay et al. 2005). The cultivated plant inventory increased toward the late Las Pircas phase (8500–7800 BP).

During the following Tierra Blanca phase (7800–5000 BP), the intensity and nature of plant cultivation changed, with a shift from single-family house gardening to multifamily fields and canal systems (Chapters 6, 11, 12). Plant use during the Preceramic phases is understood in terms of persistent hunting-gathering in much of the valley, plus a gradual adoption and proliferation of house gardening and then irrigation technology applied to community agricultural fields in the upper valley.

CONCEPTUAL BEGINNINGS

Archaeobotany (a.k.a. paleoethnobotany) has advanced rapidly in terms of methodology and more tentatively in terms of the theoretical use of plant data to understand cultural processes of change, chronological thresholds,

and the relationships of plants to higher and lower status activities, social relationships, and ideology. Plant remains provide distinctive perspectives on culture history that illuminate, refine, and sometimes contradict more traditional datasets such as lithics, ceramics, architecture, and settlement patterns (Bush 2004; Hastorf 1993; Rossen 2008; Weber 2003).

During the 1990s, the Nanchoc plant remains produced erratic accelerator mass spectrometry (AMS) dates ranging from 11650 BP to the 1950s early nuclear test era, and the ages of the plant materials were cautiously presented in our publications of archaeological materials (Dillehay et al. 1999, 2001). The solid contexts such as house floors and storage structures, the absence of indicators of disturbance or later occupations at the sites, and the ancient morphologies of the plant remains contrasted with the erratic AMS dates (Rossen et al. 1996). These identical house floor contexts had produced a series of consistent conventional radiocarbon dates based on wood charcoal remains from intact house floors and features (Dillehay et al. 2007; Rossen 1991: 150). The historic dates were particularly puzzling since the Las Pircas and Tierra Blanca areas were uninhabited in historic times, and there was no collective memory among present-day Nanchoc people of habitation or farming in the area. Nearly two decades after initial excavation and dating of the primary plants, a new set of AMS dates on both previously studied and newly excavated materials confirmed the early to middle Holocene age of the ancient plant remains (see Appendix 1).

Why the earlier AMS dates were incorrect remains unanswered. At first it was believed that the dated materials were contaminated by natural causes, such as travertine deposits in the area, but that possibility was dismissed. It is now suspected that the buried macrobotanical remains from the Nanchoc sites were contaminated by radio-labeled carbon 14 biological compounds that were present in a United States Customs laboratory in a storage facility in Miami where the samples were opened and retained for more than a month in 1987 or in a biomedical forensic anthropology laboratory at the University of Kentucky where the samples were stored between 1988 and 1995. There may be a cautionary tale concerning reliance on the use of AMS dates to winnow reliable data. Perhaps we need to reestablish the fundamental primacy of context and association in archaeology and redate questionable archaeological materials (Dillehay et al. 2007).

ENVIRONMENTAL SETTING

Investigated sites in the Zaña and Nanchoc valleys range in ancient environmental setting from the coastal *algarrobo* forests to the semi-arid and

dry tropical forest ecotones of the middle and lower upper valleys to the tropical forest settings of the upper valley proper (Dillehay and Netherly 1983). The middle to upper valley ecotones in the Nanchoc area were the center of early experimentation with and cultivation of plants. The quebradas of this zone provided direct access to multiple ecozones. Along with the upper Zaña Valley and the presence of tropical forest on the western slopes, there were unusual opportunities for cultural influences from east of the Andes. In the lower valley there were dry forest biomes including cactus and algarrobo forests and other vegetation zones. The biodiversity and consequently the foraging resources of these arid areas was not as great as that of the semi-arid seasonal forest in the upper valley zones (see Chapter 3 and Appendix 2).

The upper valley quebradas had settlement advantages over the main valley floors during Preceramic times. Vegetation was denser and there were diseases such as leichmaniasis. In all Preceramic periods, settlements were concentrated or exclusively located in the lateral quebradas. The plentiful water and small alluvial flats provided the setting for settlement and early plant cultivation. It was population rise and the accompanying need for larger farm plots and settlements that pushed people downward to the valley floors as the Preceramic came to a close (ca. 5000 BP).

EL PALTO PHASE

The El Palto phase was a time of hunting and gathering, and upvalley, the earliest presence of cultivated squash. Most plant data from this period come from the coastal plain and quebradas of the lower valleys (Stackelbeck 2008). Large stands of *algarrobo* trees still stand in portions of the lower Zaña Valley. In these areas, the shaded forest and large pod and seed masts provide a stark contrast with the open coastal desert and present a view of the Preceramic environment of the lower valley. Recent archaeological research focused in the Q. del Batán and Q. Talambo, along the eastern portion of the coastal plain in an area of alluvial fans in the Chamán and Jequetepeque valleys. This is an area of tropical desert cactus and shrub that was also dominated by *algarrobo* forest during Preceramic times. Coastal peoples were primarily focused on animal resources, yet they collected *algarrobo* (*Prosopis chilensis*) pods as well, as evidenced by the presence of their remains in sites together with, wild grasses (*Sporobolus* sp.), and fruits such as from columnar cactus (*Echinopsis* sp.). Extensive flotation of numerous sites in the lower valley produced only small amounts of carbonized plant

materials. There are no indications in the coastal zone of the incipient use of cultigens or plants that would later become cultivated.

Two squash (*Cucurbita moschata*) seeds from the lowest level of Site CA-09–77 near Nanchoc, one with an AMS date of ~10,300 BP, provide the earliest evidence of plant cultivation in the valley (Dillehay et al. 2007). This plant is more numerous in subsequent Las Pircas phase sites and is further discussed later in the chapter.

LAS PIRCAS PHASE

The Las Pircas phase was primarily a tgime of collectging wild plants, primarily in the Quebrada del Batán and the Quebrada Talambo, where a large-scale flotation effort yielded only wild plant remains like algarrobo pods and columnar cactus fruits (Stackelbeck 2008). In the Nanchoc Quebrada valley, in contrast, various plants were cultivated in small house gardens in lateral quebradas above the valley floor. The crops grown were squash (*Cucurbita moschata*), peanut (*Arachis* sp.), quinoa-like chenopod (*Chenopodium* sp. cf. *quinoa*), manioc (*Manihot* sp.), and bean (*Phaseolus* sp.). Las Pircas phase sites in the upper valleys have produced small but varied assemblages of desiccated and carbonized plant materials. Two contexts, the floors of quincha huts and a small stone storage structure of site CA-09–27, produced the majority of macro-remains (Dillehay et al. 2007; Rossen 1991; Rossen et al. 1996). Starch grains from human teeth of site CA-09–28 produced evidence of beans (*Phaseolus* sp.) and pacay (*Inga feuilleei*) (Piperno and Dillehay 2008).

The squash (*C. moschata*) from the Las Pircas phase are the same as those recovered from the late El Palto phase. They are small (6 to 7 mm in length and 2.5 to 4 mm in width) with a uniformly dark brown color and prominent seed margins (Fig. 9.1). Recent research has focused on northern lowland South America, especially Colombia, as the area of origin for *C. moschata*, based on molecular data and the occurrence of modern, primitive-looking landraces (Pearsall 2008; Piperno and Stothert 2003; Sanjur et al. 2002; Wessel-Beaver 2000). Seeds of the same size, shape, and color as the Nanchoc specimens have been found in fruits of modern traditional landraces of *C. moschata* from lowland northern Colombia and coastal Panama (Pearsall 2008; Wessel-Beaver 2000). No other species of *Cucurbita* resembles these traits. The color alone is unique to this species in a genus composed of about fourteen species, including five domesticates. Despite the small size of the specimens, the archaeological seeds were mature, because the brown seed coat does not develop until near maturation

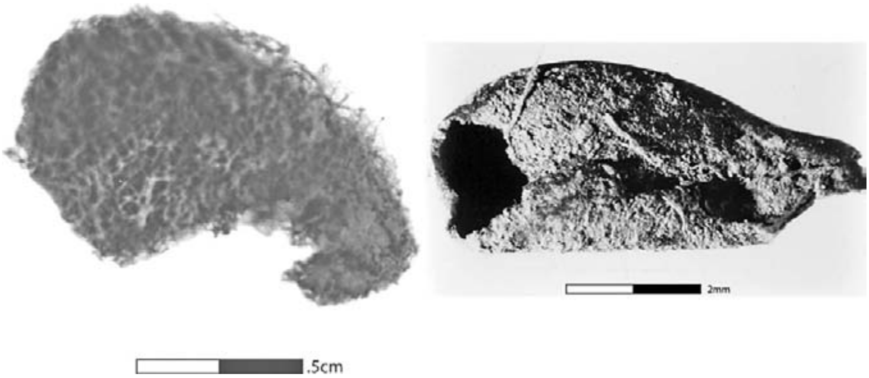


Figure 9.1. *Cucurbita moschata* squash seeds from Las Pircas sites.

(Dillehay et al. 2007). In addition to the macro-remains, starch grains of squash were recovered from teeth found in the three middle Las Pircas phase sites (Table 9.1) (Piperno and Dillehay 2008):

> The evidence firmly indicates that at Nanchoc early domesticated *Cucurbita* was routinely consumed, not used primarily as an industrial plant (e.g. containers, net floats). Moreover, as all wild cucurbits species have very bitter, non-edible flesh and a major domestication gene code for non-bitter fruits, human selection for this gene by 8,000 B.P. [8800 cal BP] is strongly implied. (Piperno and Dillehay 2008: 19624)

Peanuts (*Arachis* sp.) from the Las Pircas phase in the Nanchoc area are elliptically shaped fibrous linings and hulls of a hirsute variety (Fig. 9.2). The peanut was long thought to be one of the later cultivated plants of the Andes as well as one that is particularly well suited to the lowland tropical forests and savannahs where it was prized as a high protein complement to starchy manioc-based diets (Barker 2006; Piperno and Pearsall 1998). The center of domestication is believed to be southern Bolivia, northwestern Argentina, and/or the Matto Grasso region of Brazil, based on the geographic distribution of wild species such as *A. monticola* and *A. batizocoi* (Pearsall 2008). By all accounts, the Nanchoc area peanuts are far removed from any regions of wild *Arachis*. Peanuts have not been recovered from middle Preceramic contexts of southwestern Ecuador or Colombia, reinforcing its probable diffusion into the Zaña Valley from the eastern slopes of the Andes.

From a recent reanalysis of the peanut specimens, David E. Williams concluded that the Nanchoc archaeological specimens are not *Arachis hypogaea*, the common peanut that eventually became a staple cultigen throughout the Andes. Instead, the Nanchoc specimens represent a smaller variety of *Arachis* that could not be matched to any extant wild species of the

Table 9.1. Presence of Cultivated Plants in the Nanchoc Valley

	Cucurbita	Arachis	Chenopodium	Phaseolus	Manihot	Inga	Gossypium	Erithroxylum	Zea
Las Pircas Phase (9800–7800 BP)									
CA-09–27	X	X	X		X	X			
CA-09–28									
CA-09–52	X	X		X					
Late Las Pircas Phase (8500–7800 BP)									
CA-09–77	X	X	X	X			X	X	
Tierra Blanca Phase (7800–5000 BP)									
CA-09–71	X	X	X						
CA-09–77	X	X		X		X	X		
Terminal Preceramic Phase (5000–4000 BP)									
Cerro Guitarra							X		X

genus (Dillehay et al. 2007). There are at least two ways to view these materials. First, peanuts of the Las Pircas and subsequent Tierra Blanca phase may have been a localized and ultimately failed cultivation episode that did not receive widespread acceptance as a domesticate. It is also possible, however, that these peanuts represent a pre-domestication cultivation of a plant that would later be hybridized to become one line of *A. hypogaea* (Piperno 2006b; Seijo et al. 2007).

Figure 9.2. Fragments of *Arachis* sp. (peanut) from Las Pircas sites.

A large seeded chenopod is present in Las Pircas phase sites. The size (1.9 by 1.3 mm) and cross-section of these seeds most closely resemble quinoa (*Chenopodium quinoa*), but reticulations on the specimens differ morphologically from herbarium specimens (Fig. 9.3). Bruno has postulated 5,000 BP as a "liberal estimate" of the domestication date of quinoa in the central Andean highlands, based on morphological analysis of seeds from central and southern Peru and Bolivia (Bruno 2006: 43). In highland Bolivia, the genetic interaction between weedy and cultivated forms of quinoa, which are more locally related to each other than different cultivated varieties, indicates an area of long-term development of numerous local varieties (del Castillo et al. 2007). Although quinoa and quinoa-like chenopods may be grown in the Nanchoc area, the highland origins and ecology of quinoa, which include considerable resistance to freezing (Bois et al. 2006), contrast with the lower elevation, tropical dry forest, and northern location of Nanchoc. The Las Pircas phase specimens predate the earliest estimate of Bruno by 2,800 years. Perhaps like the peanut specimens, these seeds represent a pre-domestication cultivation phase of use, which is further discussed later.

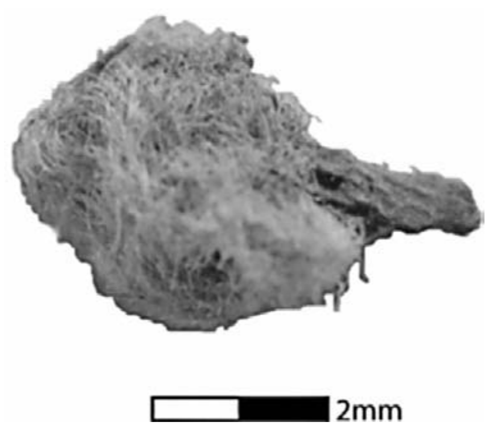


Figure 9.3. Cotton boll from house floor of Tierra Blanca phase (*Gossypium barn*).

Quinoa has several characteristics that make it an unusual cultigen. The seed bitterness, a saponin coating,

must be removed by washing before preparation for consumption, but the bitterness is an advantage in storage, because rodents and insects do not infest the seeds. Seed fragility also is a crucial attribute of quinoa. Seeds do not usually remain viable for more than one year, and quinoa must be planted every year or it may be lost to a region. Even a small of amount of quinoa in an archaeological site thus may represent a long period of local cultivation (Ugent and Ochoa 2006: 101–105).

One manioc (*Manihot esculenta*) tuber skin was recovered from the *quincha* hut floor of site CA-09–27. Scanning electron microscopy (SEM) revealed complex starch grains ranging in length from 5 to 35 microns (Fig 9.4). The cellular structure of the skin was also examined by a scanning electron microscope (SEM), and the combination of attributes allowed the identification (Peterson et al. 1985; Rossen 1991: 510–511; Ugent et al. 1986). DNA sequencing of manioc suggests that its closest wild relatives are along the southern boundary of the Amazon Basin, specifically the Brazilian states of Mato Grosso, Rondonia, and Acre (Olsen and Schaal 2006). Manioc starch grains dating to as early as 7000 BP, contemporary with the late Las Pircas phase, have been recovered in central Panama (Piperno 2006a) along with manioc graters at early sites in Colombia (Hawkes 1989: 485–487; Piperno 2007; Reichel-Dolmatoff 1965; Roosevelt 1984; Stone 1984). Though archaeological tubers are notoriously difficult to identify, a detailed study has identified manioc in late Preceramic contexts at the Peruvian central coast sites of Pampa de Ventanilla (ca. 6800 BP), the Tank site (ca. 5800 BP), and Carhua (ca. 4500 BP) (Martins 1976). Terminal Preceramic and Initial Period coastal Peru sites such as Pampa de Las Llamas-Moxeke and Las Haldas also contain manioc remains (Pozorski and Pozorski 1987; Ugent et al. 1986). The Nanchoc specimen appears to be another case of a plant being transported from east of the Andes for cultivation in slope and coastal areas west of the cordillera.

Starch grains of bean (*Phaseolus* sp.) were recovered from human teeth from sites CA-09–28 and CA-09–52 (Piperno and Dillehay 2008). Macro-remains of beans have not been recovered, but beans have long been considered to be among the earliest Andean cultigens. Genetic evidence suggests an area of domestication in the southern Peruvian highland departments of Apurimac and Cuzco (Chacón et al. 2005). Beans were recovered from early highland sites like Guitarrero Cave (Ancash), though subsequent AMS dates did not match early Preceramic dates on the strata (Kaplan and Lynch 1999). Beans have also been recovered at coastal Peruvian Late Preceramic sites like the Tank site and PV-35–1 (Bonavia 1996; Cohen 1978; Ugent and Ochoa 2006: 163).

There is also evidence of aboriculture, the cultivation of fruit-bearing trees. The seeds of plum or *ciruela del fraile* (*Bunchosia* sp.) were recovered from several Las Pircas phase sites. Two unidentified fleshy fruit berries and seeds were also recovered. One distinctive berry, probably a member of the Solanaceae family, is two centimeters in diameter with numerous tiny round seeds (D'Arcy 1986; Hawkes et al. 1979). Starch grains of *pacae* (*Inga feuillei*), a tree legume with pods containing a sweet mealy pulp (Advisory Committee on Technology Innovation 1989: 277–285) were extracted from human teeth (Piperno and Dillehay 2008). *Pacae* has been recovered from Preceramic sites of the Peruvian coast, the Pampa site (Ancon Valley), and PV-35–2 (Huarmey Valley) as early as 6500 BP (Bonavia 1996; Cohen 1978; Ugent and Ochoa 2006: 153). Several recovered plants have medicinal elements, including coca (*Erythroxylum novogranatense var. truxillense*), holly (*Ilex* sp.), nightshade (*Solanum nigrum*), and boneset (*Eupatorium* (Bonzani et al. 2004).

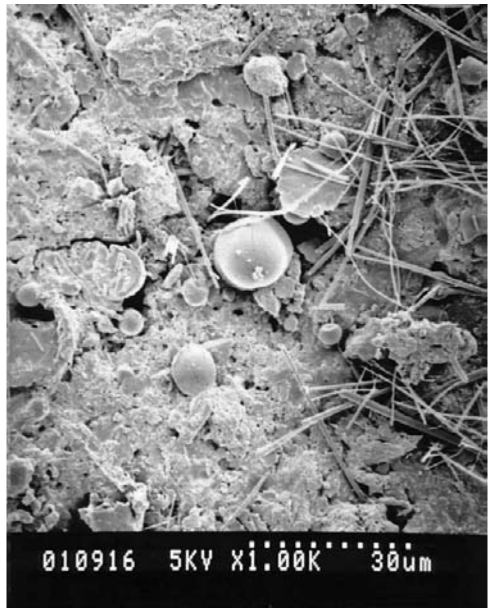


Figure 9.4. SEM shot of manioc starch grains (*Manihot esculenta*) from the floor of a hut at CA-09–27.

The Las Pircas suite of cultigens is notable because of their lowland or eastern slopes areas of origin and being transported across the Andean cordillera to the tropical, forested western slopes setting of Nanchoc. The exception is quinoa, a plant of probable highland origins. All are adapted to the well-drained sandy and eolian soils of the Nanchoc Valley and quebradas. For example, during archaeological fieldwork, Nanchoc farmers commented that peanuts would be a preferred crop to grow instead of maize because it provides great yields in local soil and climate conditions, but the seed is expensive. Peanuts are presently grown by only a few relatively wealthy farmers.

DISCUSSION: LAS PIRCAS PHASE PLANT USE

Over much of the study area, the Las Pircas phase was a hunting-gathering period with a strong focus on *algarroba* seeds, wild grasses, and tree and cactus fruits. But in at least one portion of the upper Zaña Valley (the

quebradas along the south bank of the Nanchoc River), the Las Pircas phase was a dynamic time of experimentation with and incorporation of new resources and the development of new technologies. House gardening occurred in small furrowed plots. Simple feeder ditch technology may have begun during this time. Large basalt sodbusters and hoe blades were recovered. Plants were stored in small above-ground stone structures. A varied unifacial lithic industry, the Nanchoc Lithic Tradition (NLT), was oriented to harvesting and processing plants (see Chapter 11). Ground stone bowls, slabs, and manos appear in great numbers at Las Pircas phase sites.

Las Pircas people were apparently localized, with relatively few, sporadic outside contacts, based on studies of lithic raw material. Exotic plants may thus have been brought in by procurement parties in what has been termed "embedded procurement" (Binford 1990) or through unsystematic exchange. A combination or suite of garden plants was developed that was suitable to the particular house garden conditions of the quebradas. There were other exotic materials in the forms of lithic raw material (silexes), marine shell, quartz crystals, and worn stingray spines that also attest to occasional or sporadic outside contacts and exchange (Rossen 1991: 223).

Even the earliest materials, the squash seeds dating 10,300 BP, display morphological characteristics of a domesticated variety (Dillehay et al. 2007). The squash, peanuts, quinoa-like chenopod, and manioc all appear at great distances from their origin hearths and wild ranges and were thus transported to and reestablished in the Nanchoc area house gardens. Plants other than squash do not display clear characteristics of domestication and probably represent pre-domestication cultivation, which is further discussed later in the chapter. Even fruits such as plums (*Bunchosia* sp.) and various solanaceous species are likely cultivated varieties (Dillehay et al. 2007; Rossen et al. 1996).

Was plant cultivation during the Las Pircas phase an isolated upper valley development in the lateral quebradas along the southern bank of the Nanchoc River? The evidence indicates that plant cultivation and accompanying settlement and technological changes occurred in only one pocket of the valley. Yet the evidence of sporadic contacts and the geographically diverse origin hearths of the plants themselves indicate that this development was related to other regions. Contemporary evidence of early plant cultivation in southwest Ecuador suggests there were several regions of house gardening and plant cultivation in the Andes as early as 10500 BP (Pearsall 2008; Piperno and Stothert 2003). The presence of cultivated manioc in Panama has been documented by 7500 BP, contemporary with

the late Las Pircas phase (Dickau et al. 2007; Piperno 2006a). The period of 10800 to 7800 BP was a time of dynamic culture change where many groups were experimenting with plant cultivation and domestication and were probably accepting and rejecting plants differentially based on exchange and embedded procurement access to plants and local growing conditions (Gepts 2004; Pearsall 2008).

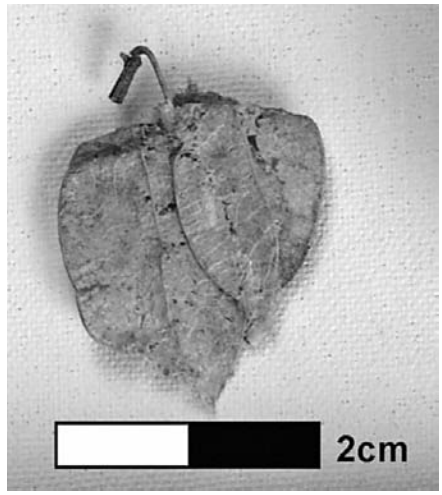


Figure 9.5. Coca leaves recovered from house floors of Tierra Blanca phase (*Erythroxylum novogranatense var. truxillense* [Rusby] Plowman).

Late in the Las Pircas phase (7800 BP), at sites like CA-09–77, cotton (*Gossypium barbadense*) and coca (*Erythroxylum coca*. *novogranatense* var. *truxillense* [Rusby] Plowman) were added to the cultivated plant inventory. These remains were found within rectangular houses and not the elliptical houses that are characteristic of most of the Las Pircas phase. These are aspects of broad-scale culture change that are particularly characteristic of the following Tierra Blanca phase.

TIERRA BLANCA PHASE

The Tierra Blanca phase was a time of both continued cultural development and reduced complexity. Subsistence data primarily exist for the upper valley. With their larger, rectangular, multi-room stone foundation houses, it is evident that populations rose. Settlements were located lower in the quebradas than during the Las Pircas phase. The entire inventory of middle Las Pircas phase cultivars except manioc is present, including macro remains of squash, peanut, and quinoa-like chenopod. Manioc has not been recovered, but it is fortuitous to recover this notoriously elusive plant. Starch grains on human teeth identify bean, pacae, and other unidentified legumes (Piperno and Dillehay 2008). The additions of cotton and coca (Figs. 9.3 and 9.5), first recovered from sites late in the Las Pircas phase, are significant. Coca leaves on house floors and the precipitation of calcite lime at the Cementerio de Nanchoc site represent the movement of ritual from household to group public contexts. Wild coca occurs in the eastern Andean slopes valleys from Ecuador to Argentina (Pearsall 2008). *E. coca novogranatense* var. *truxillense* [Rusby] Plowman is a western slopes cultivated variety that

may have originated there (Rostworowski 1973). The recovery of cotton pods represents the first cultivation of nonedible industrial plants. Cotton domestication is usually associated with the northern coast of Peru and the production of fishing nets and genetic research supports this area as the origin zone of *G. barbadense* (Westengen et al. 2005).

Tierra Blanca phase sites are generally lower in the quebradas than Las Pircas phase sites, and sites are clustered in different broader and flatter quebradas. These sites are usually associated with canals and benches above the floodplain, and thus they have different soils from those that are present higher in the quebradas where Las Pircas phase people lived. This settlement pattern shift or downward thrust implies that gardens became larger and that irrigation technology came into use (Dillehay et al. 2001; Rossen and Dillehay 1999). A study of ancient canals in the Nanchoc Valley has dated the bottom levels of stratified canals to the Tierra Blanca phase (Dillehay et al. 2005). The addition of coca and cotton during this period marks the expansion of domestication efforts with a focus on locally available plant instead of imported species that dominated earlier cultivation efforts of the Las Pircas phase.

The absence of garden crystals in Tierra Blanca agricultural fields suggests the disappearance of garden magic and house gardens, which were abandoned in favor of communal fields along the canals. Accompanying this was less careful treatment of the dead. Instead of carefully cut and placed human bone, Tierra Blanca houses sometimes contain layers of heavily crushed and trampled bones. This suggests a spiritual separation of ritual from the household and the house garden as agricultural fields became larger and multi-household, and as public places like the Cementerio de Nanchoc site developed (Chapter 7). The culminations of these changes were shifts to the lower valley aggregated hillside villages like Cerro Guitarra (Chapter 7) and later during the Initial Period, the development of expansive agricultural settlements at sites in the coastal hills such as Purulén.

TERMINAL PRECERAMIC PHASE

Maize, peanut, and cactus fibers are present at the Terminal Preceramic hillside village of Cerro Guitarra, located in the lower Zaña Valley (Chapter 7). This is apparently the first appearance of maize, a small eight-row variety, in the valley. A dry riverbed east of the site contains elevated areas with Cerro Guitarra–style unifacial lithics that may represent agricultural fields associated with that aggregated village.

The absence of maize in the Zaña Valley until the terminal Preceramic phase is conspicuous. Early maize has been reported to the north throughout Ecuador and Panama as early as 7500 BP on the basis of plant phytoliths and starch grains (Pearsall 2008; Piperno and Pearsall 1998). Intensive maize agriculture is well documented by Early Formative times, ca. 5800 BP, in Ecuador (Zarillo et al. 2008) and in the Terminal Preceramic (5000–4000 BP) on the coast of Peru (Bonavia 1982b) and in the southern Peruvian highlands (Perry et al. 2006). These last dates, from the Waynuna site, are contemporary with Cerro Guitarra. Maize with similar dates (4500 BP) has also been documented at Los Ajos in southeastern Uruguay (Iriarte et al. 2004). Pearsall's most recent model for maize diffusion proposes a southward diffusion along the eastern Andean slopes connecting the early maize cultivation areas of Ecuador and Argentina/Uruguay (Pearsall 2008). An eastern slopes diffusion pathway would explain the absence of maize among the early cultigens of the Nanchoc area and its relatively late appearance in the lower Zaña Valley.

SUMMARY

Water flotation–based studies of plant use throughout the Zaña Valley and starch grain analysis of teeth from selected sites have accumulated strong evidence of plant use during Preceramic times. Included are processes of human decision making, environment, settlement pattern, technology, and ideology that relate to both wild plant collecting and early efforts at cultivation, house gardening, and later irrigation technology in communal agricultural lands. Coastal plain and lower valley populations apparently chose to retain an emphasis on *algarroba* nuts throughout the El Palto, Las Pircas, and Tierra Blanca phases.

While most of the valley underwent a drying period from at least the beginning of the Tierra Blanca phase or even earlier, the Nanchoc pocket, an area of lateral quebradas on the south side of the Nanchoc River, appears to have retained humid to seasonally dry tropical conditions. In this zone, early house gardens developed based on a suite of plants that were transported to and established from the eastern Andean slopes. The small size of house gardens and low production levels represented by Las Pircas sites suggest a low-risk form of intensification with an emphasis on the restructuring of social relations and the intent to produce more as much as an actual increase in food production per land unit (Bender 1978). Small above-ground storage structures were present. A ritual process that accompanied the development of this localized plant cultivation system,

including possible garden magic and ritual cannibalism (Chapter 5), may have been a by-product or even a contributing factor to the intensification process.

During the Tierra Blanca phase, settlement frequency and site size increase. Coca and cotton were added to the inventory. The devolution of mortuary treatment suggests that the ritual processes that were significant to early house gardening during the Las Pircas phase were less relevant during the Tierra Blanca phase. The downward thrust of settlement toward the lower quebradas allowed larger multi-household agricultural fields, and irrigation apparently progressed from simple feeder ditches to canal systems.

Hunting and gathering based on *algarrobo* pods, grasses, and fruits persisted throughout much of the valley during the Preceramic while the Nanchoc area developed first house gardens, feeder ditches, and accompanying rituals during the Las Pircas phase and then irrigation technology and multifamily agricultural fields in the Tierra Blanca phase. Those upper valley social systems were localized, yet there was enough interaction throughout the valley in terms of movement of materials such as lithic raw material, marine shell, and stingray spines to suggest that hunting and gathering groups were aware of the gardening and then farming lifeways that had appeared. From a valleywide perspective, this leads to a conclusion that independent and variable plant-use decisions were made throughout the valley. It is possible that the moister conditions near Nanchoc afforded a cultivation option that was increasingly difficult elsewhere in the valley as a drying trend progressed during the Tierra Blanca phase. Finally, during Terminal Preceramic times, maize finally made its appearance in the archaeobotanical record of the Zaña Valley in the first aggregated villages.

MODELING EARLY PLANT USE

How do we model the development of plant cultivation (and at least in the case of squash, domestication) that had its origins in the El Palto phase, developed into a house gardening system in the Las Pircas phase, and expanded into multifamily irrigation agriculture in the Tierra Blanca phase? As stated earlier, my previous models of this regional plant-use sequence emphasized the low-risk nature of early house gardening and the relative richness and environmental stability of the Nanchoc forest and ecotones. For this reason our models tend to reject climate change as a factor in the initial development of this plant cultivation system (Rossen 1991; Rossen et al. 1996). Also, the dispersed settlement pattern and

"pseudo-dense" clustering of small sites in the Las Pircas phase has led us to reject population pressure as an early prime mover (Bronson 1977).

The concept of "pre-domestication cultivation," an intermediate stage of manipulating wild plants, may be significant in understanding the earliest portion of the Nanchoc plant development sequence (Piperno 2006b). Some Las Pircas phase plants, such as *Arachis* and *Chenopodium* sp. (cf. quinoa), both as yet unmatched to wild species or to ancient or modern domesticated specimens, may represent this stage of plant use. By 7,600 BP the presence of furrowed garden plots suggests the domestication process was under way.

In recent years, models involving behavioral ecology have gained popularity. These models combine climate change associated with the end of the Pleistocene and a decline of animal protein sources with the social circumstances, opportunities, and investment returns provided by access to new resources in new environmental settings (Bird and O'Connell 2006; Gremillion 1996; Piperno 2006b, 2007; Piperno and Pearsall 1998). These models place a premium on social learning and patterns of human decision making, in combination with traits of particular plants such as phenotypic plasticity (Gremillion and Piperno 2009). In the Nanchoc case, it may be the environmental realities of post-Pleistocene conditions and not ongoing climate change per se that provided a backdrop to the experimental behavior and adoption of several plants of varying origins and attributes. That is, the seasonally dry tropical forests of Nanchoc produced opportunities for low-risk, low-effort plant cultivation that encouraged adoption of exotic plants and accompanying technological, social, settlement, and ideological changes. Ironically, it may have been the relative stability of the Nanchoc forest within a valley that was undergoing greater environmental change (drying) that provided the optimal conditions for early plant cultivation.

In case studies in the Near East and Africa, one long-standing paradigm has been that drying trends and resource stress created the early impetus for plant cultivation (Binford 1968; Childe 1952). Climate change, however, may also be viewed as a constraint on the development of plant cultivation (Bettinger et al. 2009). Our evidence suggests that a long-term drying trend inhibited development of plant cultivation in much of the study area, while an unusually moist pocket of the upper valley allowed innovative experimentation with house gardens and later corporate farming. This does not negate behavioral ecology models that present post-Pleistocene climate changes as the baseline impetus for plant cultivation, particularly as they relate to forested environments (Piperno 2006b; Piperno and Pearsall 1998). In the Nanchoc area, social relations were transformed, public ritual

spaces were defined, and settlement patterns pushed downward from the upper narrow quebradas as the demand grew for larger cultivation areas, possibly overcoming the negative disease and land-clearing factors of living and planting in the wide valley floors (e.g., Dillehay 1991a,b; Gade 1979). As in many regions, the development of first household cultivation and then agriculture was a protracted process (Gepts 2004; Zeder et al. 2006). Early experimentation with plants led to small furrowed house gardens over an approximate 2,500 year span (ca. 10000–7500 BP). The next stage, including development of community agricultural fields with irrigation technology and new cultivation efforts on plants like coca and cotton took place over an additional 2,500 years (ca. 7800–5000 BP). (see Chapters 6, 11, 12).

Much of the Zaña Valley apparently chose not to participate actively in the early plant cultivation system that began late in the El Palto phase and during the Las Pircas phase and developed into multifamily agricultural systems during the Tierra Blanca phase. By retaining their hunter-gatherer system, they raise unanswered questions. What were all the social, technological, and environmental factors involved in the divergent subsistence trajectories within the valley? What are the historical places of particular cultivated plants like *Arachis* sp. and *Chenopodium* sp. (cf. quinoa) that do not closely resemble either wild plants or domesticated Andean crops?

What was the role of the Nanchoc pocket of plant cultivation in the broader Andean development of agriculture and cultural complexity? Although in some respects the developments of the El Palto and Las Pircas phases near Nanchoc may appear to have been an isolated development, there were clearly connections in terms of long-distance plant diffusion (the presence of plants from various origin hearths), communication pathways along the eastern Andean slopes, and contemporary cultural developments elsewhere such as southwest Ecuador, Colombia, Panama, and southern Peru. By the Tierra Blanca phase, the multifamily agricultural plots and irrigation canals foreshadow the Terminal Preceramic aggregated villages and subsequent monumental architecture to appear throughout northern and central Peru.

CHAPTER TEN

Faunal Remains

Kary Stackelbeck

Among the most significant remains recovered from Preceramic contexts in the project area were those of various faunal species. With a few exceptions at surface sites, the faunal remains were recovered from intact subsurface deposits in association with charcoal samples that yielded radiocarbon and/or AMS dates. Faunal data for the early El Palto phase are derived from dated contexts at JE-790 in the Q. Talambo and JE-996 and JE-1002 in the Q. del Batán of the lower Jequetepeque Valley. Faunal data for the late El Palto phase are derived from subsurface contexts at JE-439 and JE-993 in the Q. del Batán and JE-431 and JE-790 in the Q. Talambo. In addition, a few faunal remains recovered from the surface at JE-439 and JE-993 were included in the study because they were found in association with Paiján stone tools. Assemblages from various sites in the Jequetepeque and Zaña valleys yielded evidence of Las Pircas phase fauna, including JE-772, JE-937, and JE-1002 in the Q. del Batán and Q. Talambo areas and CA-09–27, CA-09–28, CA-09–52, CA-09–77, and CA-09–85 in the Nanchoc Valley. Only two sites yielded limited faunal data from a dated Tierra Blanca phase context: CA-09–71 and JE-901 in the Nanchoc Valley and in middle upper reaches of the Q. del Batán, respectively. In addition to these remains, large quantities of land snail shells, including middens, were recorded on or near the surface of numerous sites in the Q. del Batán and Q. Talambo.

A wide variety of faunal species are represented in the site assemblages, including numerous terrestrial mammals, birds, reptiles, amphibians, mollusks, and aquatic fish and invertebrates. These are presented in summary form by phases in Appendix 4. As noted in Chapter 3, the environment changed significantly after the end of the Pleistocene, achieving modern conditions by the middle Holocene. Increases in aridity and temperature along the coastal plains likely led to intra-regional declines in some faunal populations and shifts in biomes and habitats that attracted them, which

may account for some differences observed in the faunal assemblages over time. However, the environmental changes do not appear to have resulted in abandonment of the region by various animals with the possible exception of peccary, which are only present in assemblages that date to about 10800 BP.

The ability of the local environment of the Q. del Batán and Q. Talambo to sustain the remaining terrestrial faunal populations during the more arid early to middle Holocene period – albeit perhaps in smaller numbers – is suggested in part by the presence of certain species in the project area today, including several land snails, lizards, deer, birds, and fish. An exception to this pattern is the Nanchoc basin where the climate was not significantly altered and remained relatively warm and humid throughout the Holocene period. Although the social context and economic importance of those resources have changed, they are still used today for subsistence by local people, who inform us of how those same species may have been incorporated into Preceramic diets. Studies of modern exploitation of lizards and land snails (Gálvez Mora et al. 1994, 1999), along with informal observations of the use of deer, birds, marine mollusks, and fish, are reviewed briefly later.

METHODS

The vertebrate faunal remains from sites in the Q. de Las Pircas were identified by Sylvia Scudder under the supervision of Elizabeth S. Wing, both of the Florida State Museum of Natural History, Gainesville. The *tinamou* identification was made by Diana Matthieson of the University of Florida. Vertebrate remains from excavations after 1992 were identified by Barnett Pavao-Zuckerman using standard zooarchaeological methods (Pavao-Zuckerman 2004, 2008). All identifications were made using the comparative skeletal collections housed at the Stanley J. Olsen Laboratory of Zooarchaeology, University of Arizona. Some fish specimens were identified using the zooarchaeological comparative collection housed at the Zooarchaeology Laboratory, Georgia Museum of Natural History, University of Georgia (Pavao-Zuckerman 2004: 5–7). A number of primary data classes were recorded during identification, including (1) elements represented, (2) the portion recovered, (3) symmetry (left vs. right), and (4) number of identified specimens (NISP). Cross-mending specimens were counted as single specimens. The only exceptions to these procedures were materials identified only as bone (Vertebrata), which could not be counted or identified due to their fragmented condition.

Terrestrial invertebrate faunal remains (i.e., land snail shells) were observed in large numbers on the surface of eighty-one El Palto sites, thirty-two Las Pircas, and eighteen Tierra Blanca sites. The relative density of land snail shells observed on the site surface was recorded, particularly if they occurred in mounded shell middens. Samples of these land snail shells were recovered from intact subsurface deposits including El Palto contexts (at JE-431, JE-439, JE-790, JE-996, and JE-1002), Las Pircas contexts (at JE-772, JE-937, JE-1002, CA-09–27, CA-09–28, and CA-09–52), and Tierra Blanca contexts (at CA-09–77, CA-09–71, JE-901). All land snails from subsurface excavations were retained; these specimens were bagged by provenience and weighed (the number of individual shells were counted at sites CA-09–27, CA-09–28, and CA-09–52 [Rossen 1991]). In addition to these terrestrial specimens, limited evidence for marine invertebrates was recovered from several assemblages. With one notable exception, these marine mollusks were collected from sites in the Nanchoc area (CA-09–27, CA-09–28, CA-09–52, and CA-09–85). The only other marine shell from a Preceramic context consisted of a specimen that was recovered from a Las Pircas feature at JE-1002 in the Q. del Batán; this shell had been modified for use as a bead. The recovered marine specimens and a representative sample of the land snail shells (from surface and subsurface contexts) were submitted for identification and analysis (Mora Costilla 2003).

As a result of these analyses, other more specific data were recorded – particularly for the vertebrate faunal remains (e.g., minimum number of individuals [MNI], age-at-death, and weight [Janz 2007; Pavao-Zuckerman 2004]). However, for the purposes of the present study, we are concerned with only general diachronic patterns evident from the presence or absence of certain species in El Palto, Las Pircas, and Tierra Blanca assemblages. Faunal remains with evidence of alteration (e.g., marks that they were cut, burned, or otherwise modified through human activity) provided some additional observations with regard to differential treatment or processing over time (Janz 2007; Pavao-Zuckerman 2004).

HABITATS OF THE EXPLOITED FAUNA

By examining the typical habitats of faunal species exploited by early and middle Preceramic populations of the Jequetepeque and Zaña valleys, we obtain an idea of (1) the paleoenvironmental conditions that characterized the project area, and (2) the areas from which nonlocal species were derived. Despite the arid conditions of most of the study area today, several

species of mammals, reptiles, and birds continue to be present. Deer, fox, rodents, iguanas, desert *tegu*, iguana, snakes (including boa constrictors), parakeets, doves, raptorial birds, puma, jaguar, *jaguarundi*, *tinamou*, bear, among other species (with the exception of puma and jaguar), have been observed in the *chaupiyunga* ecozone between the coastal plains and the highlands. Given that these and a variety of other species are present in early to middle Preceramic archaeological deposits in the project area, we can surmise that the environmental conditions of the terminal Pleistocene to the middle Holocene were sufficient to sustain a wider diversity – and perhaps larger population – of animals than what is seen today. Somewhat wetter and more temperate conditions characterized this area of the lower western slopes of the Andes during these early occupations (Pavao-Zuckerman 2004: 32).

Invertebrate remains from archaeological contexts also offer insight into the paleoenvironmental conditions. Land snails, such as *Scutalus*, are commonly found in *lomas* zones (Dillon 1994, 1997; Dillon and Rundel 1990) and the forested western slopes of the Andes (Gálvez et al. 1994), though they may also be found in other habitats (Rossen 1991: 548). Land snails are typically found clinging to trees, cacti, or under rocks. During El Niño//Southern Oscillation (ENSO) events, with increasing rain and humidity, the number of land snails likewise increases (Gálvez et al. 1994: 57). Numerous *Scutalus* have been identified among El Palto and Las Pircas sites in the Jequetepeque Valley, likely reflecting the more humid conditions of the terminal Pleistocene and early Holocene. In addition to *Scutalus*, other species of land snails, including *Bostryx* and *Coleoptera*, have been identified in Las Pircas and Tierra Blanca deposits in the Nanchoc area. These species are today more commonly found in river valleys along the central coast of Peru (Rossen 1991: 549). The presence of these snails in middle Preceramic deposits (8000–5000 BP) is considered to be an indicator of more humid environmental conditions in the Nanchoc basin of the upper Zaña Valley (Rossen 1991: 549).

While most of the animals exploited by Preceramic populations in the Zaña and Jequetepeque valleys were locally derived terrestrial species, some were from marine, littoral, and estuarine settings. Among the varieties of fish identified in El Palto, Las Pircas, and Tierra Blanca assemblages are those that tend to inhabit waters adjacent to the coastline (Chauchat et al. 2006). These include varieties of *Micropogonias*, *Mugil*, and *Sciaenidae*, among others. Some of these fish also inhabit estuaries and tidal ponds, which are likewise adjacent to the coastline (Gálvez and Quiroz 2008: 71). In addition to fishes, some marine mollusks from sandy and rocky littoral zones, are

also represented – specifically in Las Pircas deposits of the Nanchoc area. The proximity of the majority of the El Palto, Las Pircas, and Tierra Blanca occupations in the project area to these near-coastal and coastal habitats would have varied from the terminal Pleistocene to the middle Holocene based on changes in eustatic sea level due to deglaciation (Fairbanks 1989; Richardson 1983; Richardson and Sandweiss 2006; Sandweiss et al. 1998a). Today, the coastline lies approximately 20 km from the lower western slopes of the Andes. The early and middle Preceramic populations who occupied the western flanks area could have acquired coastal resources indirectly through exchange networks or directly through seasonal patterns of mobility.

The 1989 faunal collection from the Q. Las Pircas corroborates several other lines of evidence that suggest the Nanchoc region was more humid and forested during the Las Pircas Tierra Blanca phases than today. Large snakes such as racers and boas are present but rare near Nanchoc today and are suggestive of a relict population. Deer today tend to be concentrated farther upvalley in more forested zones. Frogs are visible in great numbers during the December to April rainy season in the upper Nanchoc Valley floor, but not in the now-dry lateral quebradas. Present-day lizards are primarily the larger iguana, which is better adapted to modern semi-arid conditions than the smaller lizards found archaeologically. Perhaps most significant, the *jaguarundi* and *tinamou* specimens suggest a moist forested environment during the Las Pircas phase. These fauna do not have strong implications for seasonality of occupation of the sites.

SEASONALITY DATA

In addition to providing information on the general environmental conditions, some species also represent seasonality indicators. The presence of lizards, deer, and land snails, for example, may indicate occupation of a given site during the austral summer months (December to March; Pavao-Zuckerman 2004). Lizards, such as desert *tegu*, hibernate during the austral winter months and are thus easier to find and capture when they come out of hibernation (Pavao-Zuckerman 2004: 30). Deer were probably drawn to river valleys and *algarrobo* forests during austral summer months, when there was increased plant growth along the riverbanks (Reitz 1988). Land snails, such as *Scutalus* sp., are more abundant during austral summer months (Mora Costilla 2003), though they were observed in the project area year-round. Also, their numbers increase during periods of increased moisture and rainfall, such as occurs during El Niño events. Herbaceous

vegetation and new growth deciduous trees and shrubs would have been seasonal.

The remains of desert *tegu* and other lizards were recovered from five El Palto sites (JE-431, JE-439, JE-790, JE-993, and JE-1002) and three Las Pircas sites (JE-772, CA-09–27, and CA-09–52). Several varieties of deer were identified in the assemblages from the project area, including whitetail deer, pampas deer, brocket deer, and other indeterminate cervids. Deer remains were identified in the faunal assemblages of two El Palto sites (JE-439 and JE-993) and five Las Pircas sites (JE-908, CA-09–27, CA-09–28, CA-09–52, and CA-09–77). As noted above, land snails were documented in large quantities at dozens of sites in the study area. The presence of lizards, deer, and terrestrial mollusks at these sites does not preclude occupation during other seasons – even year-round. Indeed, all of these resources may be obtained during other seasons besides the austral summer months. For this reason, it is important to examine other indicators, such as midden development and the presence of architecture and other features, to assess the temporary or permanent nature of occupation at any of these sites. Of interest is the fact that domestic architecture is present at four of the El Palto sites (JE-431, JE-439, JE-790, and JE-1002), five of the Las Pircas sites (JE-937, CA-09–27, CA-09–28, CA-09–52, and CA-09–77), and two of the Tierra Blanca sites (CA-09–71, CA-09–77) that contained lizards, land snails, and/or deer in their faunal assemblages, suggesting at least tendencies toward longer term occupation at these locations.

TECHNOLOGICAL CONSIDERATIONS

In assessing the changes and consistencies associated with early and middle Preceramic diets, it is important to consider also the associated technologies that would have facilitated the exploitation of the various faunal species. Understanding the tools that were likely used to exploit these fauna have implications for our evaluation of the concomitant changes in lithic technology and the extent to which specialized skills were or were not required.

The larger mammals represented in these Preceramic faunal assemblages, including deer, peccary, carnivores, and jaguar, were likely hunted with spears. Wooden spears could have been tipped with stone projectile points, such as those of the Paiján and Fishtail varieties, or other material (e.g., antler, bone, or wood). Smaller animals, such as fox and lizards, were likely captured using traps, slings, or well-placed nets. These methods would

not necessarily have required stone tools, except to cut the cane, reeds, bark, or small branches that were used to produce the primary implement. Terrestrial snails were simply collected by removing them by hand or with the use of a stick from the cactus, boulder, or tree to which they adhered. As noted by Gálvez et al. (1994: 66), modern snail collectors sometimes place a net or blanket on the ground to catch the snails as they are plucked off to increase the efficiency of collection. Additionally, Gálvez et al. (1994: 69) observed the use of cactus spines to extract the meat of the snail from its shell. It is reasonable to suggest that Preceramic populations used similar techniques and expedient, simple tools to acquire the land snails that occur in abundance on so many sites. The varieties of fish identified among the Preceramic assemblages represent species that largely derive from shallow, near-coastal waters, estuaries, areas of brackish water, and perhaps even freshwater settings, such as rivers. Chauchat et al. (2006) have proposed that Paiján populations of the nearby Chicama Valley used spears tipped with their distinctive needle-nosed projectile points to harpoon fish in these shallow waters. Alternatively, Gálvez and Quiroz (2008) suggest that nets would have been sufficient technology – perhaps even the preferred technology – to capture the various fish consumed by these early populations. In sum, hunting or capturing the variety of animals represented in the early and middle Preceramic faunal assemblages discussed here would not have necessarily required the use of formal bifacial stone tools – though that certainly does not preclude the fact that sometimes such tools were used for such tasks. Furthermore, processing any of these animals could have been achieved with bifacial, unifacial, or simple flake knives and scrapers, or simply by hand (as with the snails and lizards).

DIACHRONIC PATTERNS OF FAUNAL EXPLOITATION

Several patterns are observed in the constituent species by phase and through time. Differential distribution of certain species among the El Palto, Las Pircas, and Tierra Blanca faunal assemblages reflect changes in paleoenvironmental conditions; differential preferences for animals – either for use as subsistence resources or for their ceremonial or medicinal qualities; patterns of mobility that incorporated other ecological zones outside the project area; evidence of small group cohesion through collective subsistence activities; and/or potential evidence of exchange networks established with other resident populations that occupied those zones.

Early El Palto phase fauna in the study area included both terrestrial and limited marine species, such as South American fox, New World

rats/mice, desert *tegu* and other indeterminate lizards, stingrays, crabs, and land snails. The late El Palto phase faunal regime includes most of the same species as found in earlier phases (e.g., South American fox, desert *tegu*, rodents, land snails), along with numerous new resources, including deer, peccary, mustelids, tree squirrel, indeterminate carnivore, ungulate, dove/pigeon and other birds, salamander, various marine fishes (e.g., Pacific porgy, finebarbel croaker, lefteye flounder, drum/croaker, indeterminate shark/ray), and mullet, a type of fish that may be from saltwater, brackish, or freshwater habitats. By the Las Pircas phase, populations continued to exploit both terrestrial and marine resources, though the constituent species had changed somewhat. As with the early Preceramic assemblages, Las Pircas fauna included the South American fox, deer, indeterminate carnivore, ungulates, desert *tegu*, rodents, crabs, stingray spines, and land snails. But we also see the introduction of new types of mammals (*jaguarundi* and indeterminate canine), birds, Andean *tinamou*, mockingbird, thrush/thrasher, and cormorant), reptiles (*Callopistes flavipunctatus*, iguana, and racer-like snakes), frogs, and a variety of marine mollusks. The limited faunal data from dated Tierra Blanca phase occupation, which was characterized by more intensified agriculture and probably a reduction in hunting wild game, consisted of indeterminate mammal, mullet, indeterminate bony fish, and land snail remains.

El Palto and Las Pircas phase assemblages include both terrestrial and aquatic resources. This is significant as it indicates that early and middle Preceramic populations made use of a wide variety of resources that would have been available within localized areas of the lower western foothills – where most of the sites in these phase are located – as well as those derived from coastal waters and riverine or brackish water settings. Taken together with other lines of evidence regarding settlement patterns (see Chapter 12), it is possible that El Palto populations acquired coastal resources directly as part of their seasonal mobility patterns, while Las Pircas populations gained access to such resources indirectly through exchange networks.

There are several species that are common to each phase, including the South American fox, desert *tegu*, rodents, and terrestrial snails such as *Scutalus* sp. Each of these species represents a small-yield resource that would not have provided much sustenance if only acquired in small numbers. When acquired in larger quantities, they represent a more substantial part of a diverse diet. Even in lesser quantities, small fauna can be a vital component of a broad-based diet. Further, the acquisition of land snails and lizards may have significant implications with regard to social organization of these populations, based on ethnographic data from the north coast

of Peru (Gálvez Mora et al. 1994, 1999). For example, land snails occur throughout the project area among El Palto and Las Pircas sites – typically in the form of large, dense middens that include hundreds to thousands of shells mixed with other evidence of cultural activity (e.g., hearths, charcoal, other faunal remains, etc.). This suggests that the snails were processed – and perhaps collected – through the communal efforts of a group. Given that such midden areas have been documented on both El Palto and Las Pircas phase sites in association with multiple domestic structures further suggests the communal nature of snail collection and consumption for these early populations. These communal activities may have additionally served as an important social bonding activity. Similarly, as noted by Gálvez Mora et al. (1999), hunting lizards in northern Peru today is an important social activity, though it is limited to smaller groups of men who are often led by an elder. In modern context, lizard hunting is perhaps less about acquiring food resources and more about solidifying social relationships between younger and older men – who may or may not be related – through storytelling, consumption of alcohol, and the act of hunting itself. It is possible that acquiring lizards, such as desert *tegu* and iguana, during Preceramic times may have involved similar patterns of cooperative efforts among small groups of people.

The acquisition of fox, lizards, and land snails does not require complex technology. In fact, any one of these resources may be captured or collected with simple technology that makes use of only vegetal materials, such as sticks, snares, or nets, among other techniques (Gálvez Mora et al. 1994, 1999). Tools such as spears tipped with bifacial projectile points may have been used to hunt large iguanas, but they certainly were not necessary nor would they have been useful in acquiring snails or smaller lizards, such as desert *tegu*. This may explain why these resources were present in the faunal regime throughout the Preceramic period regardless of the predominant type of lithic technology – be it the formal bifacial and unifacial technology that characterized the El Palto phase assemblage or the informal unifacial and expedient flake tools that constituted Las Pircas and Tierra Blanca phase technology.

Peccary remains also were identified in late El Palto faunal assemblages from at least two sites in the Q. del Batán drainage, but they do not appear to be part of later assemblages. It is possible that the increasing aridity and temperatures that are thought to have characterized the shift toward the middle Holocene in the lower Jequetepeque Valley may have facilitated a reduction in habitat favored by peccary, thus causing these animals to relocate outside of the project area by Las Pircas times.

Other species that were present in El Palto assemblages but absent in later deposits include tree squirrel, mustelids, possibly salamander, and several marine fishes (i.e., Pacific porgy, finebarbel croaker, lefteye flounder, and indeterminate drum/croaker). The presence of cormorant bones and marine shells at several late Las Pircas sites indicates either exchange with coastal populations or direct procurement of littoral resources. Andean *tinamou*, mockingbird, and thrush/thrasher from Las Pircas sites suggest a more temperate and humid environment in the Nanchoc area during middle Holocene times.

The remains of indeterminate mammals and vertebrates were found in assemblages from all phases; as such, it is possible that there are still other similarities or differences not represented in the patterns observed above.

FAUNAL ASSEMBLAGES AND DOMESTIC ARCHITECTURE

It is of interest to examine the distribution of faunal remains not only by site and phase but also by domestic context. As discussed in Chapters 4 through 6, simple domestic structures have been documented on several El Palto, Las Pircas, and Tierra Blanca sites in the project area. Four late El Palto sites (JE-431, JE-439, JE-790, and JE-954) and five Las Pircas sites (CA-09–27, CA-09–28, CA-09–52, CA-09–77, and CA-09–85) yielded faunal remains. Many of the same patterns observed for diachronic changes and consistencies in the species represented in faunal assemblages described earlier pertain to these sites. However, considering the contexts from which these materials were recovered, there may have been changes in socioeconomic organization over time.

Among the late El Palto sites with domestic architecture, faunal remains were entirely recovered from midden zones that were located outside of the structures. For example, at JE-790 in the Q. Talambo area, the midden zone and constituent faunal remains were located adjacent to four semilunar and "L"-shaped, stone-lined structures (Stackelbeck 2008). The juxtaposition of the midden area and the structures appeared to represent an early form of private-public separation of space. Without any evidence of intact deposits, features, or prepared living surfaces within the structures themselves, the subsistence remains associated with their occupation derived entirely from this nearby midden (Stackelbeck 2008: Figs 6.33, 6.34). This midden area was interpreted as a domestic activity area where numerous land snails, rodents, desert *tegu*, mullet, and indeterminate mammals were likely processed and consumed communally (Stackelbeck 2008: 332). Positioning

food preparation activities outside of the house was similarly evident at JE-431, JE-439, and JE-954 during the El Palto phase.

The pattern of food preparation appears to have changed by the Las Pircas phase. Las Pircas domestic structures contained intact living floors and deposits that yielded the remains of activities that occurred within the house, including food preparation and probably consumption. The recovery of faunal remains from extra-domestic contexts indicates that such activity occurred in both spatial contexts. However, this still signals a shift from preparing food only outside the house in a public setting to also doing so in the more private setting of the house. It is possible that this reflects concomitant changes in socioeconomic organization, the increased separation of private and public spaces, and delineation of the activities that were appropriate to each. This is consistent with other changes in the conceptualization and use of space that are associated with this phase, specifically the advent of construction for two low mounds at the Cementerio de Nanchoc site (Dillehay et al. 1989; see Chapter 7).

SUMMARY

A few propositions can be made to explain changing land-use patterns through time from the perspective of the fauna collections. Sampling bias partially accounts for the different patterns. Early sites are best represented in the faunal record. This is likely because the earlier societies dedicated more time and energy to hunting and to bringing larger quantities of bone back to campsites. The poorest representation is the later Tierra Blanca phase. This is not unexpected, given the shift away from intensive hunting and gathering to intensive agriculture by this time. The bone assemblage from the intervening Las Pircas phase reflects less reliance on hunting than in the El Palto phase, which coincides well with increased crop production and house gardens.

Given the relatively close juxtaposition of many different ecological zones in the study area, why do we not see more variety in the faunal assemblages from sites for each phase? One reason is the growing reliance on plant foods throughout time, which determined the quantity and diversity of animal bones recovered from sites. Another is the differential preservation of organic remains in sites, with the best preservation in the lower elevated, more arid zones of the study area, that is, the Q. del Batán and Q. Talambo areas. If people living in the more centrally located zones, such as the tropical dry forest in the Nanchoc Valley, were exploiting

a wide variety of fauna from neighboring areas, then the Las Pircas and Tierra Blanca sites should be yielding the greatest variety of bone material, which is not the case. This may be due to the mixed foraging and farming economy and the poorer preservation of organic materials in the forest setting.

Last, it also is probable that increased settlement localization through time reduced the opportunity to hunt in distant zones or to exchange for external resources, especially during the Tierra Blanca phase. Even given the changing climatic and environmental conditions through time in the study area, sites from all three phases generally reflect the exploitation of local fauna. This is in sharp contrast to plant species, which reveal constant contact with distant groups and the intrusion and adoption of exotic crops, beginning in the late El Palto phase with the introduction of squash, presumably from areas to the north.

CHAPTER ELEVEN

Technologies and Material Culture

Tom D. Dillehay, Greg Maggard, Jack Rossen, and Kary Stackelbeck

Summarized in this chapter are descriptions of the major material technologies recovered during the course of all projects in the study area, including architecture, irrigation canals, garden plots and agricultural fields, exotic curiosities, copper ore and crude smelted copper, and lithics. More emphasis is placed on architecture and lithics because they are the dominant assemblages recorded by all projects.

ARCHITECTURE

El Palto Phase: During the late Paiján subphase, we see the first evidence for substantial architecture, which has important implications for reduced mobility and possibly sedentism. Late Paiján architecture typically is characterized by circular or semicircular, ground-level structures that appear as stone teepee-rings with narrow entrances (Fig. 11.1). Other structural forms documented for the El Palto phase in the Q. del Batán and Q. Talambo areas include L-shaped and V-shaped huts (Stackelbeck 2008). Foundations or retaining walls were built of dry stone, usually with a conical morphology. Sometimes these walls are preserved up to 50 cm in height, though the foundations in the Q. del Batán and Q. Talambo areas typically consist of a single layer of basal stones. Some structures at the CA-09–27 and PV-09–19 sites have concentric circles or postmolds indicative of a support framework for substantial walls and a roof (see Chapters 4 and 5). Walls were likely made of wooden branches, mud covered and draped with animal skins or brush. The roofs were likely made of brush. There is no evidence of mud brick or wattle and daub.

Most structures are interpreted as having domestic functions; they were usually 1.5 to 2.5 m in diameter and often contained small round fireplaces (~30–50 cm in diameter). Some structures contain room fill, but

Figure 11.1. Late Paiján stone-lined circular structure.

the identification of floors is difficult due to wind deflation, though some have preserved packed dirt. Two exceptions are sites JE-431 and JE-439 that had a series of intermittent thin occupational floors (~0.5 to 1.5 cm in thickness) and culturally sterile lenses indicative of periods of abandonment (see Chapter 4). Postholes are rarely preserved, but artifact clusters are found on the floors, suggesting the internal spatial organization of activities within the hut. Houses at some sites were carefully laid out, being aligned along the length of the crest of an alluvial fan. Some small pits located both inside and outside the structures were possibly used for storage. Most sites with architecture contain only a few structures, with a maximum of eight. The sturdiness of hut construction and the fact that they are often closely grouped together in small clusters suggests that they required more planning than preceding early Paiján campsites without more solid structures. These sites are classified as short-term or seasonal base camps of nuclear families.

As mentioned in Chapter 1, we consider the late Paiján structures to have been occupied by "proto-households" (Bogucki 1999). As basic units of production, proto-households are considered to be associated with impermanent occupation and a limited set and duration of foraging activities. The sites occupied by proto-households usually have thin and discontinuous occupational floors, less intensive tool manufacturing and food preparation activities (as evidenced by a generally low to moderate quantity and diversity of artifacts), and the presence of few features. In comparison, sites

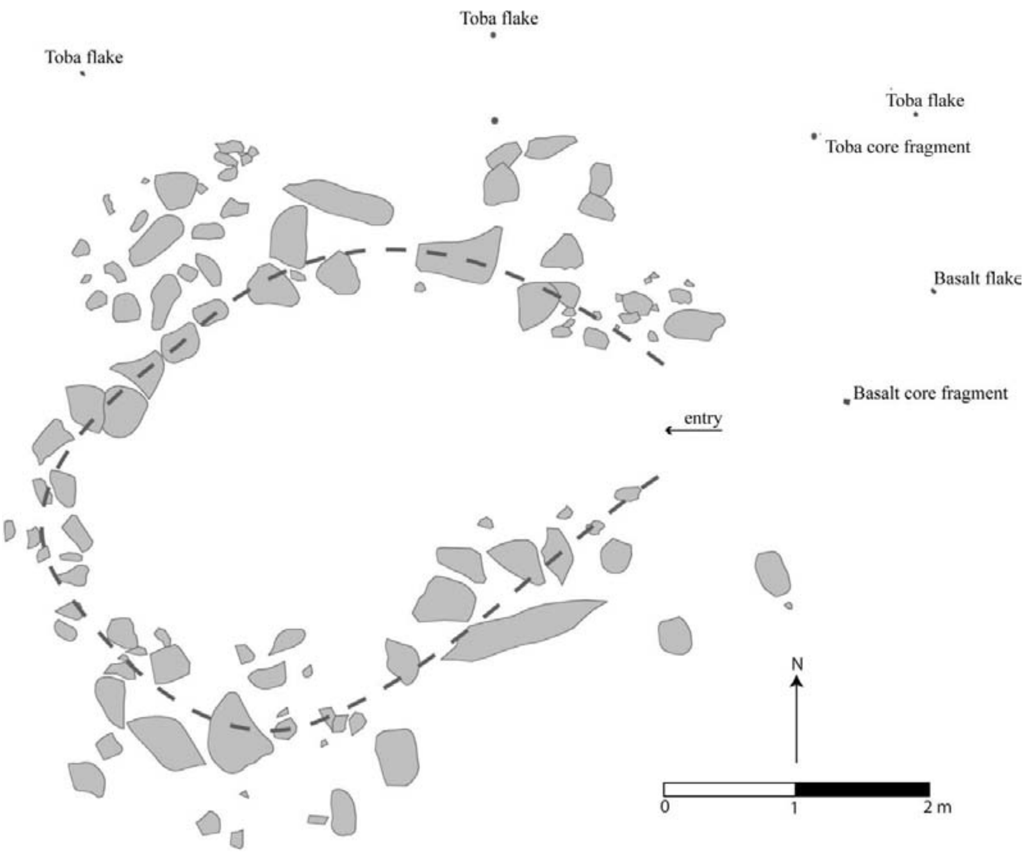


Figure 11.2. Circular house structures of the Las Pircas phase at site JE-971.

occupied by "households" of the later phases tend to be larger, have thicker and continuous floors, and exhibit a greater number and diversity of tools and features.

Las Pircas Phase: It is in architecture that some Las Pircas sites stand out from those of their late Paiján predecessors. In the Nanchoc basin, Las Pircas structures continue to be round but are larger in size, generally ranging in diameter from 2 to 3.5 m, although a few large houses are located downvalley in the Q. del Batán and Q. Talambo (Figs. 11.2–11.4). At one site, CA-09–27, there was use of adobe or mud bricks for hut foundations (see Chapter 5). The walls and roofs were probably made of branches and hides. Little information is available on roofing, although roofs were probably similar to those described for the late Paiján subphase. Most structures have minimal floor preparation in the form of packed earth. Entrances to structures are through a gap in one end of a wall. The shape of these structures is relatively consistent, but their size and internal organization is varied. Floors are usually continuous and extend

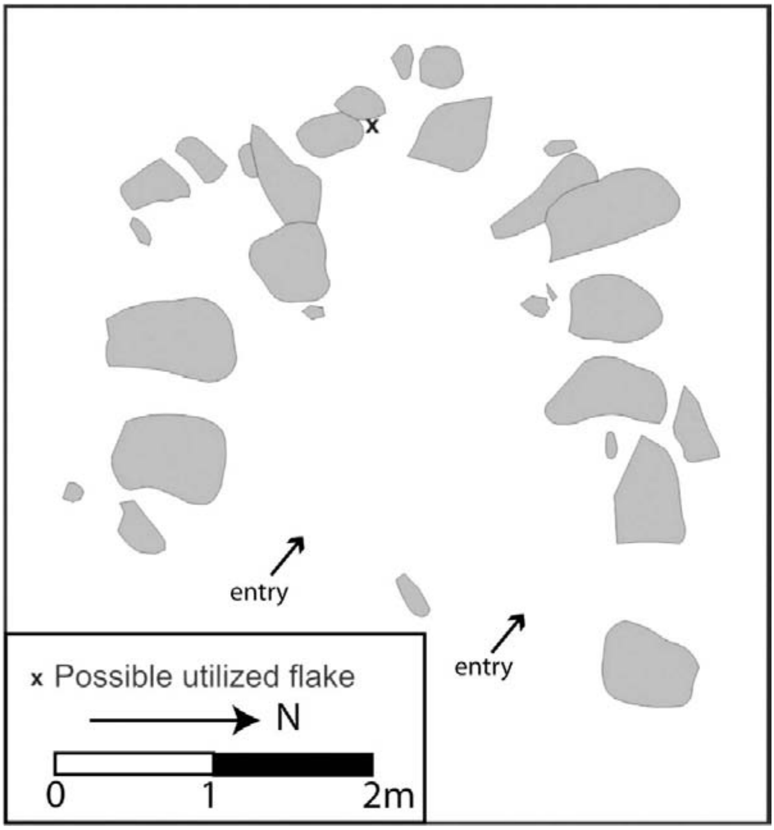


Figure 11.3. Semicircular or U-shaped house structures of the Las Pircas phase at site JE-970.

to a maximum depth of 30 to 60 cm, indicative of a more permanent occupation.

The domestic use of these structures is evidenced by the presence of ground stone and other artifacts, fire hearths, floral and faunal remains, and storage features. These structures are typically oval, circular, or semi-circular (see Chapter 5). These are free-standing, isolated structures; they do not cluster but are associated with nearby house or kitchen gardens (Rossen 1991; see Chapter 5). Based on their larger size, greater diversity of artifacts and features, and thicker and continuous floor deposits, these sites are classified as loosely scattered but integrated communities of households.

Tierra Blanca Phase: At the end of the Las Pircas phase and the beginning of the Tierra Blanca phase, houses become larger and semicircular to rectangular (Fig. 11.5–11.6). By 7800 to 7500 BP, the major innovation from the former to the latter phase is the change from circular or oval structures to well-formed often multi-room rectangular houses. There are, however, considerable regional and chronological variations. For example,

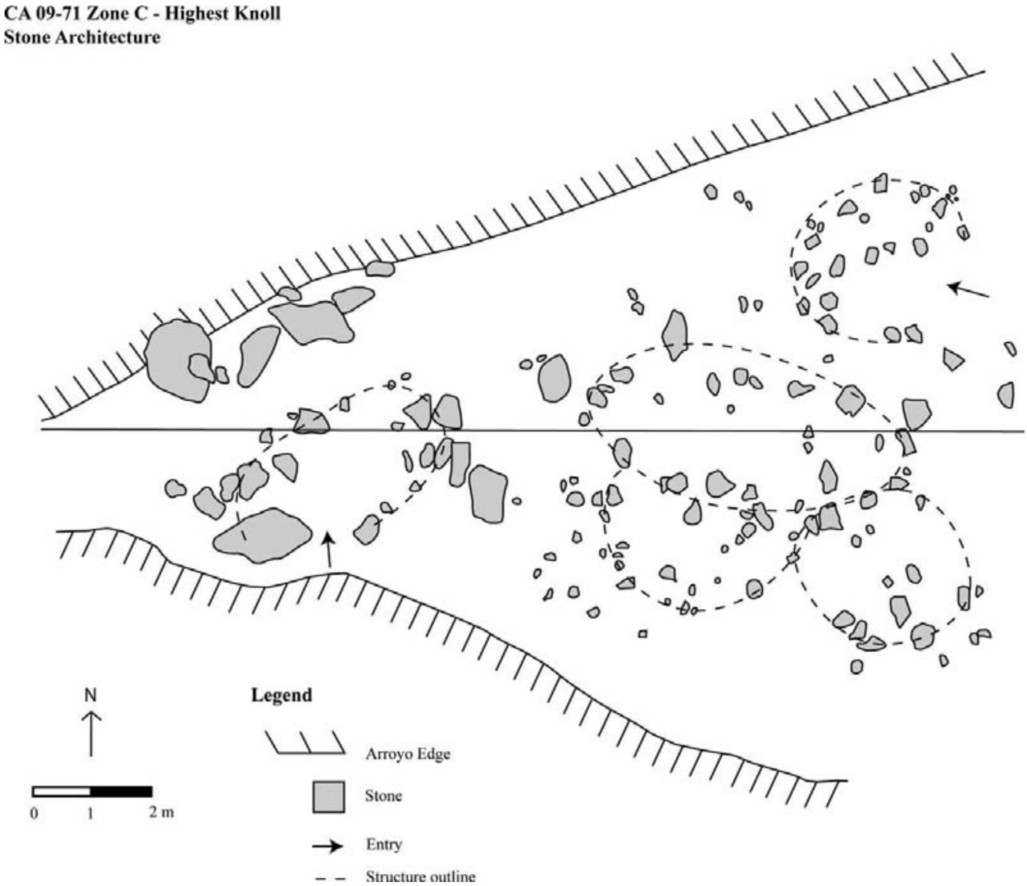


Figure 11.4. Plan of semicircular to semi-rectangular houses at CA-09–71 in the Nanchoc basin.

in the Nanchoc basin, multi-room rectangular houses are quite common. These consist of free-standing rectangular structures with an entrance in one of the long house walls. These structures were made of field stones; there is no evidence of the mud brick walls that characterized some late Las Pircas structures. These houses also are internally partitioned and often had a central hearth and an adjoining storage facility. The internal divisions of these structures consist of small square cells that measure about one to two square meters and probably served as additional storage areas. Floors are thicker (ca. 5–12 cm) and more continuous and deeper (40–90 cm) than late Las Pircas floors, suggesting more prolonged and intensive occupation. Slightly greater number and diversity of artifacts and features are associated with these sites. No nearby garden plots have been found at Tierra Blanca phase sites. Rather, Tierra Blanca phase houses are typically clustered near the lower portion or edge of alluvial fans where irrigation canals and community agricultural fields are located. As noted previously,

Figure 11.5. View of terminal Las Pircas–early Tierra Blanca phase house with floor and central hearth dated around 7800 BP (PV-19–46). The house is an amorphous semicircular form.

two sites (CA-09–73 and CA-09–77) reveal several house structures and storage units, some of which are semi-agglutinated and suggest the development of more closely knit social units.

Curiously, the two terminal Pleistocene village sites, Cerro Guitarra (PV-19–54) and probably JE-734, with more tightly packed and sometimes agglutinated structures, consist of circular houses rather than rectangular ones. At Cerro Guitarra the seventy-nine elliptical, semi-subterranean houses are clustered in groups of four to six (see Chapter 7). This indicates that there is no fixed progression of house form from one phase to another and that some local Preceramic populations either returned to or continued with circular or elliptical house forms. Although little is known about site JE-734 because it has not been excavated, Cerro Guitarra is known to be a mixed terrestrial and maritime forager and farmer society, as evidenced by the presence of cultigens, animal bones, and marine products. The house floor sequences excavated at Cerro Guitarra also reveal intermittent, probably seasonal, occupation and abandonment indicative of semi-permanency. Based on the architecture at these two late Preceramic sites, house forms may be more a reflection of settlement permanency and type of economic practice than of social structure. Both the circular Las Pircas and rectangular Tierra Blanca houses are associated with agriculture, but the latter is associated more with intensive food production and sedentism. Later,

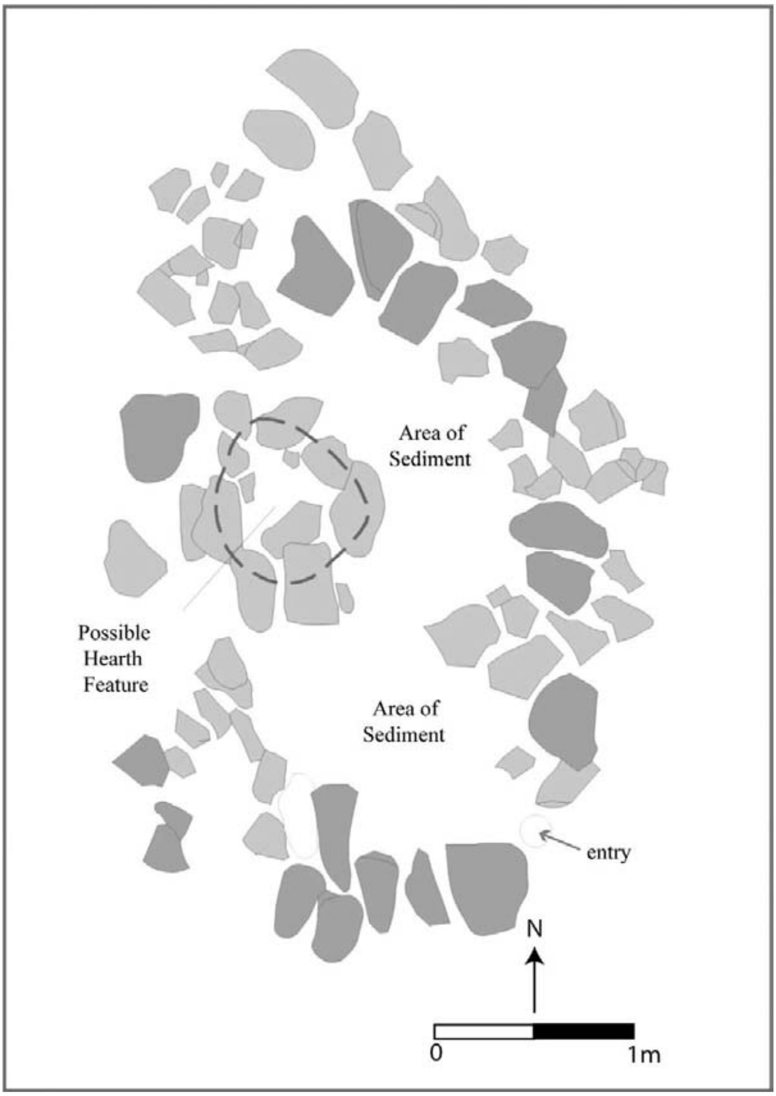


Figure 11.6. Semi-rectangular structure with possible internal hearth at JE-937, a Tierra Blanca phase house.

during the Initial Period (ca. 4500–3500 BP) all house forms in the lower and middle valleys are rectangular and presumably indicative of longer term occupancy.

CANALS

Sections of two and possibly three Preceramic buried canals were excavated along the margin of alluvial fans adjacent to the banks of the Nanchoc River (Dillehay et al. 2007). Fragments of probable ancient canals also

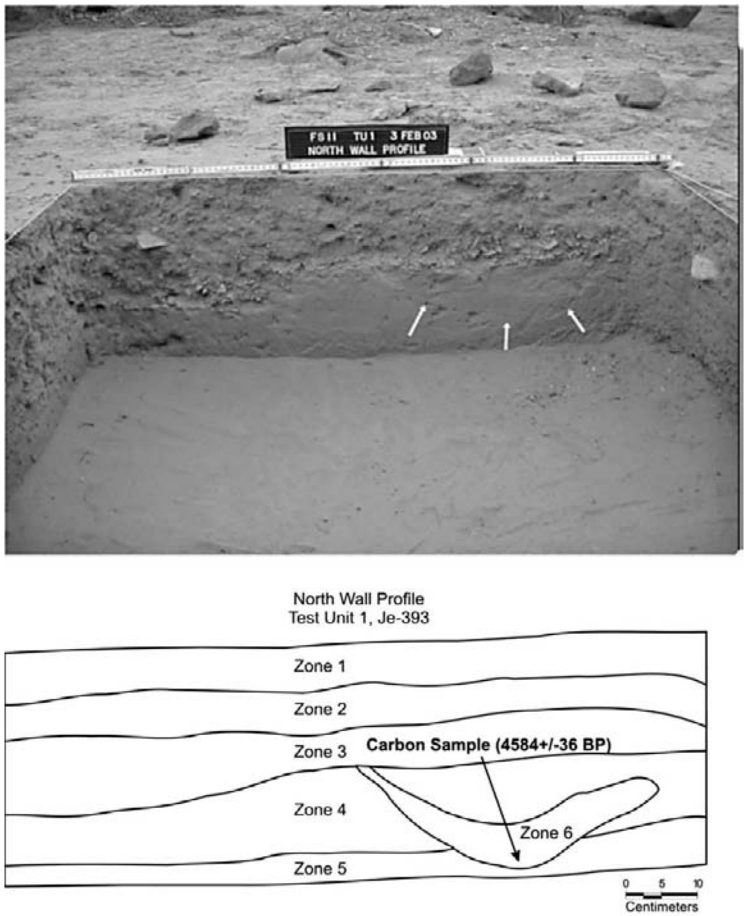
were exposed in Preceramic deposits at sites JE-393 and JE-901 in the Q. Talambo (Fig. 11.7; see Stackelbeck 2008). In addition to their v-shaped to u-shaped shallow basins and the water-laid silt and gravel that partially fill them, other criteria point to their construction and use as canals. These canals are located along the lower edges or margins of quebrada fans just above the lower fertile benches or terraces adjacent to natural waterways, the same contour location where later Prehispanic and modern canals are situated. In the Nanchoc area, there are four superimposed canals dating from 7500 to 850 BP and increasing in size from early to late times (see Appendix 1 and Dillehay et al. 2007).

The upper canal dates to the Late Intermediate Period (∼1800 BP), is the largest, and is visible on the surface today (Figs. 11.8–11.10). This canal is approximately 3 km in length. Given the depth of the older Nanchoc canals below the present-day ground surface, it was impossible to determine their full lengths. However, three stratigraphic profiles placed along stream embankments draining into the Nanchoc River suggest estimated lengths of ∼1.5 to 2 km. The two canals found in the Q. Talambo area appear to be much shorter and associated with smaller natural drainages. For instance, at site JE-393, the canal runs through the domestic site and may be associated with a nearby house garden similar to the ones excavated by Rossen at site CA-09–27 or simply a ditch feeding water to a domestic area. In site JE-901, the ditch seems to represent a small irrigation canal providing water to a low bench overlooking a natural drainage, a pattern similar to that of the deeper canals in the Nanchoc area. Given the buried nature of the older canals in both the Nanchoc and Talambo areas, no intake or outtake canals were located. Brief descriptions of the canals follow.

Nanchoc Canals: A possible older canal at a depth of 3.5 m is dated to 7500 BP. Its length is not known. About 80 cm above this canal is a drainage ditch dated to 6100 BP. It has been exposed in three profile cuts and is estimated at 2 km in length and averages about 30–40 cm deep. This canal is slightly larger, filled with gravel and silt and occasionally aligned with rock fragments acting as impediments to erosion (Fig. 11.10). The third canal is about 1 m above the second one and dates to 4900 BP. This canal is wider than the lower two but only about 30 cm deep. The highest and youngest canal is on the surface, is much larger, and is lined with stones.

PRESERVED GARDENS AND AGRICULTURAL FIELDS

Garden plots with furrows were excavated at sites CA-09–27 and CA-09–52. These sites are located in the upper to middle upper reaches of the



Zone 1: Pinkish Gray (7.5 YR 7/2), slightly compact, fine silty sand with pebble inclusions

Zone 2: Grayish Brown (10 YR 5/2), slightly compact, fine silty sand with pebble inclusions

Zone 3: Yellowish Brown (10 YR 5/4), loose to slightly compact, fine silty sand with pebble inclusions (75-80% pebbles/rocks--angular to subangular gravels)

Zone 4: Light Yellowish Brown (10 YR 6/4), slightly compact, fine silty sand

Zone 5: Pale Brown (10 YR 6/3), slightly compact, fine silty sand with pebble inclusions

Zone 6: Pinkish Gray (7.5 YR 6/2), slightly compact to compact, fine silty sand with pebble inclusions (rudimentary canal)

Figure 11.7. Drainage ditch or canal (arrows) at site JE-393 in the Quebrada Talambo.

Figure 11.8. Dark line shows location of Preceramic canal in the Nanchoc basin.

quebrada fans and have never been subjected to plowing in late Prehispanic and modern times. The garden furrows, which run perpendicular to the downslope drainage direction, are about 25–60 cm below the present-day ground surface (see Chapter 5).

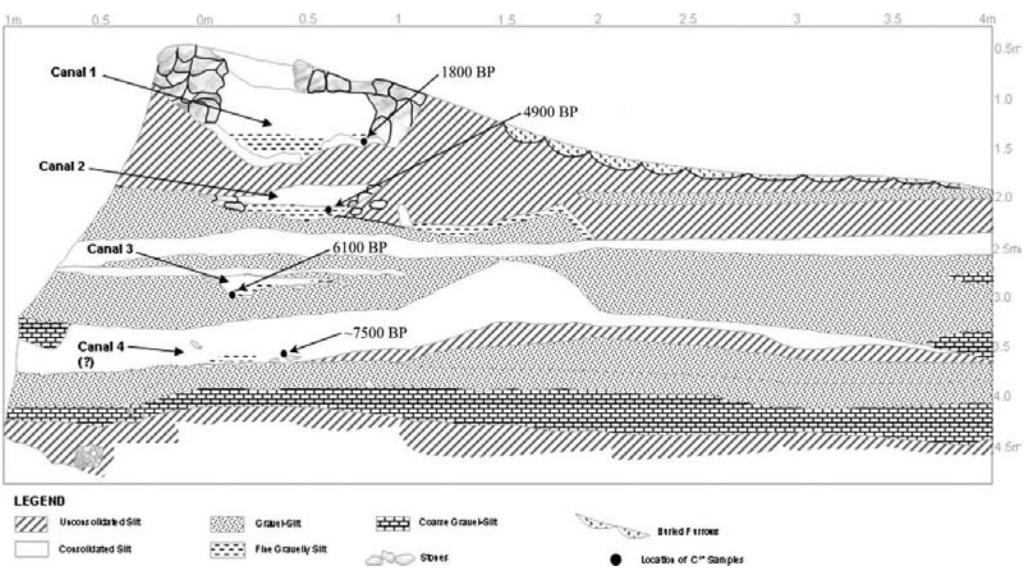


Figure 11.9. Terrace cut in the Nanchoc basin showing vertical sequence of canals.

The second kind of field consists of agricultural plots located on the low terrace or bench above the Nanchoc River and below Tierra Blanca houses located along the edge of the Tierra Blanca and Q. Sin Nombre. Buried furrows also were excavated here and found in association with unifacial flakes and waisted hoes made of basalt and andesite. Given their buried position, the presence of Preceramic lithics, their location next to Tierra Blanca houses, and the absence of ceramics and later sites, these plots appear to date to the late Preceramic period.

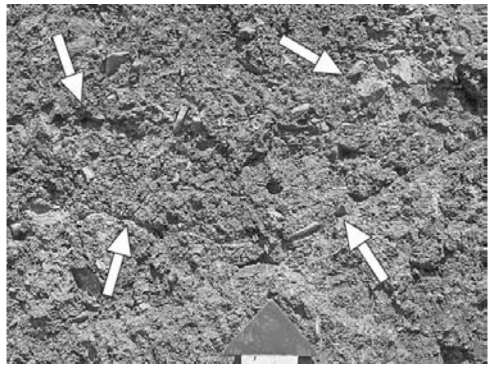


Figure 11.10. Close-up of one of the deeper Preceramic canals in the Nanchoc basin.

Based on subsurface and surface cultural materials, we estimate that the individual house garden plots were about 300 m^2 in size and the agricultural fields were about 1.5 to 3 hectares in size (Rossen 1991).

EXOTIC CURIOSITIES

Several exotic materials indicative of exchange with distant groups or the direct exploitation of distant resource zones were excavated exclusively in Las Pircas houses of the Nanchoc basin. These items include silex or jasper (n = 5), rock crystals (n = 44), fossilized shells (n = 4) from the highlands and stingray spines (n = 5), purple shells (n = 6), and numerous exotic plants (Fig. 11.11; see Dillehay et. al. 1989; Rossen 1991). Copper ore and smelted copper, which may be from local or distant source areas, were recovered from Las Pircas houses. Further, a bead made from an exotic marine shell from northern Peru or southern Ecuador was recovered from a Las Pircas feature at site JE-1002 (~10500 BP) in the Q. del Batán (Stackelbeck 2008).

CHIPPED COPPER ORE AND SMELTED COPPER

A small amount of distinctive dark green copper ore was chipped on Las Pircas phase sites. In the Q. de Las Pircas, copper ore is 0.4 percent of all analyzed chipped lithics (n = 125) (Rossen 1991: 223). The entire reduction sequence is present, including cores (n = 3), primary flakes (n = 3), secondary flakes (n = 50), tertiary flakes (n = 61), and tools (n = 8), and these materials are spatially scattered throughout sites

CA-09–27 (n = 44), CA-09–28 (n = 12), CA-09–52 (n = 61), and CA-09–85 (n = 8). There are modified boulder outcrops of copper ore at the top of the Q. de Las Pircas and also about 3 km farther downvalley, a one-half to one hour walk from the domestic sites where the chipped ore was recovered. (Lechtman [1979] reports the location of a Chimu (~AD 1400) copper mining site located near these outcrops.) This ore is attractive for its color but is only medium grained. Much of the recovered copper ore was heat treated to facilitate control of concoidal fracturing during chipping.

Chipped copper ore was not present at Tierra Blanca phase sites, but two small smelted copper artifacts were recovered from the terminal Las Pircas levels at sites CA-09–71 and CA-09–77. These are apparently small ornaments, one drilled bead and one triangular pendant (see Fig. 11.11 d,e). These are among the earliest heat-treated metal objects recovered in the Andes and date between 7,500 and 6,000 years ago. There was evidence that initially native copper was worked; simple copper heating occurred sometime after 7,500 years ago. However, it would have been a simple process where oxide ores were involved and one not requiring temperature over 700–800 C, which could have been reached by burning hardwoods of the local forests. The exact mechanisms and processes surrounding the development of Andean metallurgy remain elusive, but most research has focused on the Early Intermediate Period (ca. AD 100–500) and later (Abbott and Wolfe 2003; Centeno and Scorsch 2000; Lechtman 1979; Merkel et al. 1994). Like the domestication of plants, it is possible there were various regional pathways and learning processes involved. We note the heat treatment of copper ore at the Las Pircas phase sites because it was not employed on the finer grained basalts, andesites, and rhyolites that were the most commonly used lithic raw materials. Did one process of experimentation with metallurgy begin here with the heat treatment of copper ore for chipping lithic tools? What observations of heat-treated copper ore may have led to the extraction of copper? These are issues that further research and perhaps experimental archaeology might address.

LITHIC TECHNOLOGY

Although the lithic technology already has been described in brief for each of the previously presented phases in Chapters 4 to 6, a more detail account is given here.

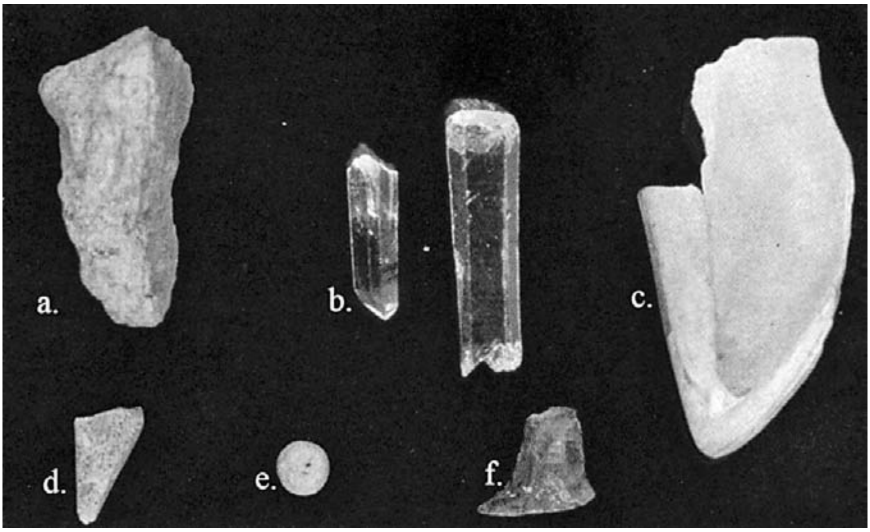


Figure 11.11. Curiosities from Las Pircas phase sites: (a) flaked copper ore; (b) rock crystals; (c) pinkish purple shell; (d-e) heated copper ornament fragments (d is a fragment of a triangular pendant and c is a bead); (f) fragment of worked jasper tool.

The Preceramic period of the Central Andes is relatively unique in the New World in that it encompasses the material traces from the first explorers/settlers; early, small-scale horticulturalists; and larger scale sedentary societies with specialized economies, early monumentality, and proto-urbanism (i.e., Caral in the Supe Valley; Dillehay et al. 2004; Shady et al. 2001). Lithic tools and debris are the most common artifacts recovered from these varied Preceramic period sites and thus perhaps warrant more analytical attention here. As such, the analysis of lithic materials can provide important insights regarding technological strategies, stylistic variation, and functional differences between assemblages and sites that form the baseline for reconstructing larger patterns of technological organization and subsistence practices and for making broader inferences about changing mobility patterns, settlement strategies, and social interaction (Andrefsky 1998; Odell 2003).

Within the Zaña and Jequetepeque valleys, the long Preceramic period has been divided into three phases – the El Palto, Las Pircas, and Tierra Blanca. Lithic materials recovered during survey and excavation of sites in the Zaña and Jequetepeque valleys provided an opportunity to examine the technological and functional changes that accompanied many of the broad-scale patterns noted during the Central Andean Preceramic period. The general technological strategy, tool types, and diagnostic tools (if any) for each of these phases are discussed next.

El Palto Phase

El Palto phase lithics are the earliest artifacts known in the Zaña-Jequetepeque region and consist of an early and late subphase. Early El Palto subphase lithics are comprised of at least three distinct technological traditions – early unifacial flake tools, Fishtail projectile points, and early Paiján points and tools (see Chapter 4). The earliest of these traditions is evidenced by several unifacial flake tools found within a buried context at the El Palto site in the Zaña Valley dated to ~13,500 BP (Dillehay 2000a,b). These lithics consist of flakes and debris struck from amorphous cores and manufactured of quartzite, quartz, rhyolite, and tuff. Few sites containing very early flake tools have been identified on the Peruvian north coast, but the El Palto unifacial materials strongly resemble other early unifacial lithics identified at sites farther to the north, including Amotape and Las Vegas (Richardson 1981; Stothert et al. 2003).

In contrast to the early unifacial tradition, the Fishtail and early Paiján lithics are more readily recognized and have been more widely documented due to the presence of diagnostic bifacial tool forms. Although easier to identify, Fishtail (~12000–11500 BP) lithic technology is relatively poorly understood in the north coast. Fishtail projectile points show considerable variability in form across the relatively few known sites in northern Peru (Briceño 2004; Maggard 2010). Thin and wide stemmed, pronounced and rounded shoulders, and fluted and unfluted varieties have been documented (Briceño 2004; Chauchat and Zevallos 1979; León C. et al. 2004; Maggard 2010). At present, it is unclear if this variability represents distinct types of Fishtail points, reflects geographic variation within the same type, or indicates temporal variation.

On the north coast, Fishtail points are typically found in association with Paiján points and tools (Briceño 2004; Maggard 2010). The four sites containing Fishtail points identified in the Q. del Batán of the lower Jequetepeque also contained Paiján lithic materials. At present it is unclear if this pattern reflects contemporaneous use of sites by Fishtail and Paiján groups, exchange, or reoccupation by later Paiján groups. Although the presence of Paiján lithic materials limits our ability to identify other tools that may have comprised the Fishtail tool kit, it appears that that Fishtail lithic technology likely emphasized the production and curation of portable, reusable bifacial tools.

Raw materials used in the manufacture of Fishtail points – which are predominantly nonlocal cherts and chalcedonies from highland sources and quartz crystals from local sources – are relatively distinct from those used

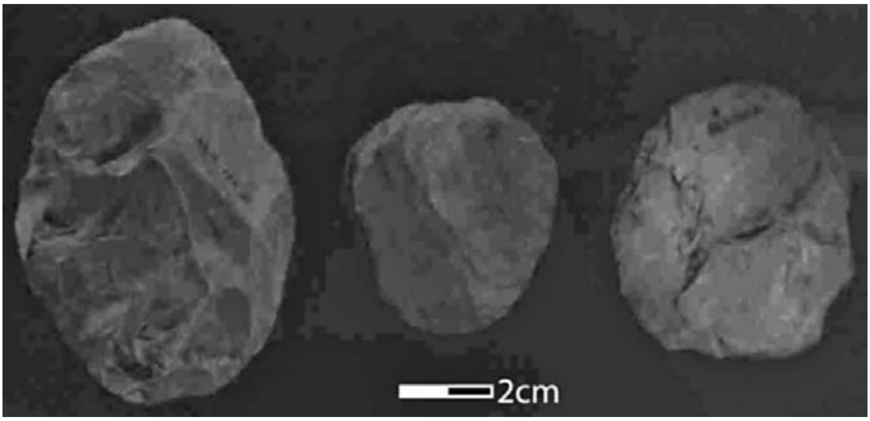


Figure 11.12. Retouched scrapers of the El Palto phase.

in contemporary early unifacial flake tools and early Paiján tools. Other tools manufactured from similar raw materials and found on Fishtail sites include small unifacial scrapers and retouched flakes (Fig. 11.12; Maggard 2010). Lithics recovered from Fishtail sites in Uruguay, Argentina, and Chile also typically include stemmed points and unifacial flakes and end scrapers (Nami 2007; Suárez 2003).

Early Paiján Subphase

Early Paiján lithic materials are also characterized by a diagnostic projectile point – the classic Paiján point (straight, narrow stemmed form). However, in contrast to Fishtail lithics, early Paiján sites and assemblages are much more common in northern Peru and have been more intensively studied (Chauchat et al. 2006; Gálvez 2004; Maggard 2010). Like the Fishtail, early Paiján lithic technology produced curated bifacial tools. However, early Paiján tool kits also contain a relatively wide range of both formal and expedient unifacial tools that are probably related to the broadening of subsistence practices as groups become more localized.

Both Chauchat (Chauchat et al. 2004: 9–11) and Malpass (1986: 99) have noted the typically long length of Paiján points (suggesting an average length of 10–16 cm). However, none of the classic Paiján points within the Q. del Batán and Q. Talambo assemblages approach the lengths they report (commonly 6–9 cm in length). The haft characteristics (straight, narrow, elongated stem) of classic Paiján points are relatively uniform but the blade shape and shoulder form may show substantial variation. This may indicate that the classic Paiján point type has greater variability in size, particularly length, than previously known. Conversely, it is also possible

that the discrepancies in size and variability in blade shape may indicate a greater degree of tool resharpening and conservation than previously considered.

The presence on some classic Paiján points of pronounced needle-nosed shaping of the distal portion of the blade has been well documented (Chauchat et al. 2004). Analysis of classic Paiján points from sites in the Zaña-Jequetepeque region suggests that the needle-nose shaping may be a product – at least in part – of extensive resharpening along the distal blade margin and not the original blade form (Maggard 2010). As Chauchat and others have noted (Chauchat et al. 2004: 9), Paiján points tend to contain edge grinding along much of the lateral margins of the blade to remove their sharpness. The presence of edge grinding along substantial portions of the blades of classic Paiján points may indicate that they were deeply hafted within a foreshaft and bound around much of the extant blade. Retouch and resharpening on a tool hafted in this manner would occur along the distal portions of the blade – which is precisely where the classic needle-nose retouch is located.

Raw materials used for manufacturing classic Paiján points include a relatively wide variety of materials. However, in the Zaña-Jequetepeque region there seems to be a preference for fine-grained quartzites (Maggard 2010). Rhyolite was also used in manufacture, but in lower frequencies than the more common fine-grained quartzites, which outcrop at numerous locations within the region and are also common in cobble form within quebrada drainages. Less well represented, yet locally available, raw materials include quartz (crystal, semi-opaque, and opaque) and a coarse-grained quartzite. In the Cupisnique/Chicama region to the south, Chauchat and others have reported a similar variety with a preferential focus on specific raw materials (Becerra 1999; Chauchat et al. 2006). In the Cupisnique/Chicama region, points were overwhelmingly manufactured from the abundant and locally occurring rhyolite (several varieties) and green tuff. Fine-grained quartzite and quartz are also noted, but in much lower frequencies.

Other types of early Paiján tools include *limaces*, several unifacial forms, and retouched and utilized flakes (Fig. 11.13). *Limaces* are well known from Paiján sites in the Peruvian north coast (Chauchat et al. 2006; Gálvez 2004; Maggard 2010). Interestingly, *limaces* do not appear to be present in contemporary assemblages from far northern Peru and southern Ecuador (Richardson 1981; Stothert et al. 2003), in assemblages from the northern and central Peruvian highlands (Rick and Moore 1999), or apparently, in

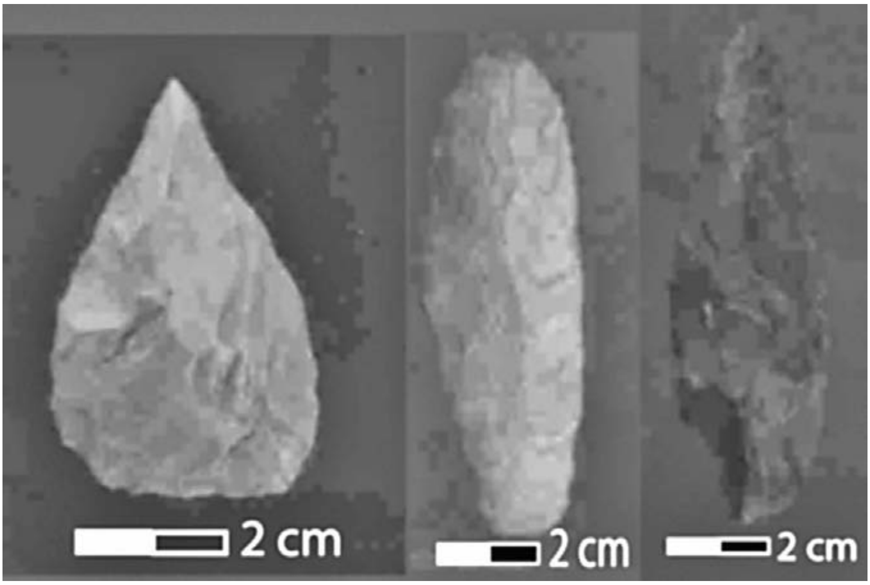


Figure 11.13. *Limaces* of the late Paiján phase.

assemblages from southern Peru (Lavallée et al. 1999; Sievert and Wise 2001; Wise 1999). The relatively limited archaeological expression of *limaces* is suggestive of a geographically and temporally restricted tool form that may be related to specific late Pleistocene/early Holocene environmental conditions (such as the forested slopes or mixed parkland-forests of the north coastal quebrada drainages). It is unclear what the specific uses of *limaces* may have been, although they have been suggested to have functioned in some capacity as woodworking implements (Chauchat et al. 2004; Dillehay 2000a,b). This suggestion seems reasonable given the "heavy-duty" appearance of the tool (i.e., thick in cross-section, typically large and heavy, and steep sided). Regardless of their specific function, *limaces* were apparently subjected to serious stress during use and are commonly found with transverse hinge fractures across the medial or distal portions that resulted in tool failure.

A wide range of unifacial tool forms has also been documented in early Paiján assemblages on the north coast (Chauchat et al. 2006; Maggard 2010). Within the Zaña-Jequetepeque assemblages, these forms include ovate, tear-drop, waisted, nonparallel, small bi-pointed, and triangular (Fig. 11.14). However, the ovate and tear-drop forms are the most common unifacial forms. At present, we do not understand the functional differences that may have existed between different unifaces. It is clear, however, that formal unifaces – and *limaces* – were integral components of the early and

late Paiján tool kits. Perhaps more important than their bifacial counterparts, these tools could have fulfilled a wide variety of potential functions and many were apparently curated and successively resharpened.

Early Paiján lithic technology emphasized the production of formal tools through both bifacial and unifacial reduction strategies. The tool kit was relatively diverse – compared to the contemporary early unifacial and Fishtail assemblages – and is suggestive of a broad range of subsistence activities. Formal unifacial forms from sites in the Zaña-Jequetepeque region and elsewhere in northern Peru are not necessarily expedient tools and provide an argument against equating all unifacial technology with expediency. Rather, early Paiján unifacial technology encompassed both formal and informal reduction strategies that cannot be neatly parsed into the standard curated versus expedient framework.

Late Paiján Subphase

The late Paiján is highly similar to the early Paiján with respect to the presence of a wide range of formal and informal tool types and the use of both bifacial and unifacial reduction strategies. In spite of these similarities, there are important differences between early and late Paiján lithic assemblages. Most notably is the replacement of the classic Paiján point with three distinct point forms – Talambo, contracting narrow stem, and contracting broad stem (Maggard 2010). Collectively, these three types comprise the late Paiján assemblage and are believed to range in age between ~10800–9700 BP based on associated dates from excavation contexts. The spatial distribution of the different late Paiján point types varies considerably, but they frequently co-occur on sites and are considered to be roughly contemporaneous. These types are neither as internally consistent nor as long lasting as the earlier classic Paiján type but display a similar heavy reliance on locally available raw materials for manufacture.

It is unclear, at present, if the late Paiján types are technologically descended from the earlier classic Paiján type. Paiján points from the Talambo area have clear affinities with the earlier classic Paiján type as both share straight stems. The relationship between the classic Paiján and the contracting narrow and contracting broad stem points, however, is not as clear. The appearance of contracting stem forms between ~11500–10800 BP that are contemporary with straight stemmed forms is suggestive of the introduction of a new technological tradition into the region. It is possible that the contracting stem form is a legacy of the earlier Fishtail stem forms and represents increased regionalization of Fishtail technologies

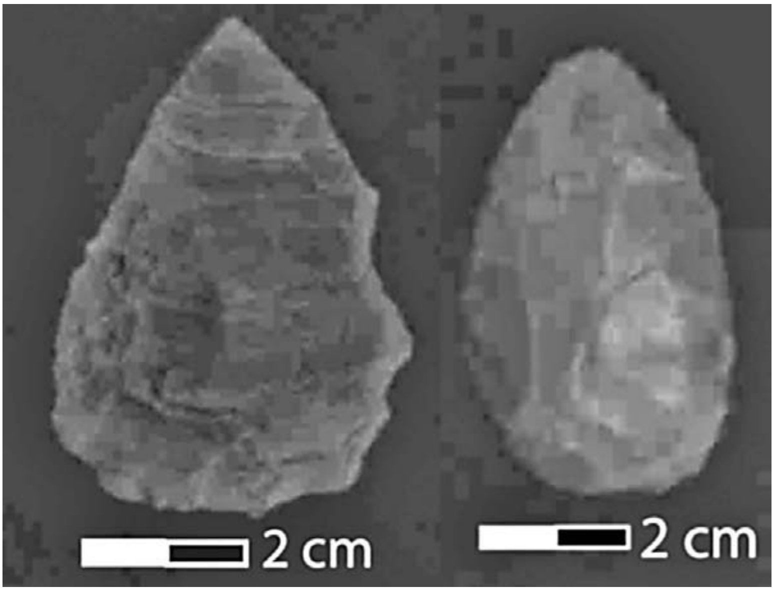


Figure 11.14. Various tear-drop shaped and triangular shaped unifacial tools of the Paiján phase.

over time. It is also possible that the contracting form represents contact with or movement of highland groups into the coastal foothills sometime during the early Preceramic period (after 11500 BP). It may be that the late Paiján, as it is defined here, represents two distinct technological traditions that operated coterminously within the region.

However, the existence of the tool kits associated with the different Paiján projectile point types appears to argue against the presence of different technological traditions (Maggard 2010). Early and late Paiján tool kits are highly similar and contain a wide range of similar to identical formal unifaces, *limaces*, and retouched and utilized flakes that indicate relatively similar subsistence practices over time within the region. It seems more likely that the rising diversity of point types that characterizes the late Paiján is related to ongoing localization, reduced mobility, and perhaps, growing social distance between groups.

Increasing localization during the late Paiján is indicated by subtle changes in the composition of the Paiján tool kit. The late Paiján tool kit, as a whole, reflects broad spectrum resource use through a wide range of individual tool types. Formal unifacial tool types are more common in early Paiján tool kits, while informal retouched and utilized flake tool types comprise higher percentages of late Paiján tool kits (Maggard 2010). A trend of reducing formality and increasing expediency characterizes late Paiján tools. Based on frequencies of tools associated with the different

point types, there appears to be a gradual shift in the importance of plant resources between the early and late Paiján subphases.

A number of groundstone implements (including both *manos* and *batanes*) were identified on sites containing late Paiján points in the Q. del Batán and Q. Talambo areas. For example, at the single component site of JE-449, a late Paiján contracting narrow stem point was found in association with a grinding stone and a small, stone-lined structure. Associations like these reflect the larger trends of reduced mobility and rising importance of plants as subsistence resources that are believed to have been occurring along the western flanks of the Central Andes around or after 10800 BP (Dillehay and Rossen 2002; Piperno and Dillehay 2008; Stackelbeck 2008).

Las Pircas Phase

Las Pircas phase lithic materials are characterized by a predominance of informal, expedient, flake-based reduction. Las Pircas lithics contrast with earlier Fishtail and Paiján materials not only with the absence of bifaces but also with fewer formal unifaces. These assemblages do, however, share affinities with the much earlier and expedient El Palto unifacial materials and with the Paiján in the use of groundstone (which is much more frequent in Las Pircas assemblages). Besides the absence of bifaces, the Las Pircas lithics are characterized by a general absence of tool retouch and rejuvenation and a high percentage of simple utilized flakes, all classic traits of expedient lithic industries (Binford 1977, 1979). It has been argued that the shift to more expedient tool production is correlated in the Zaña-Jequetepeque region with the advent of early horticulture and semisedentary occupations (Dillehay and Rossen 2002; Rossen 1991; Stackelbeck 2008). Reduced mobility and a rising importance on plant resources within the context of a broad-spectrum economy probably placed new demands on raw material acquisition and conditioned the development of a range of unifacial tool types.

Within the Nanchoc sites of the forested upper Zaña Valley, there are more recurring forms among the tool assemblages, including core tools, denticulates, and formal unifacial tool types with nonmarginal edge trimming (Rossen 1991, 1998; Fig. 11.15). Although a minority of the collections, a few heavily used relatively finely made unifacial tool types are more curated than the remainder of the industry. Local raw materials dominate the assemblage and include basalt, andesite, rhyolite, diorite, and tuff. While raw material was locally abundant, it was not plentiful

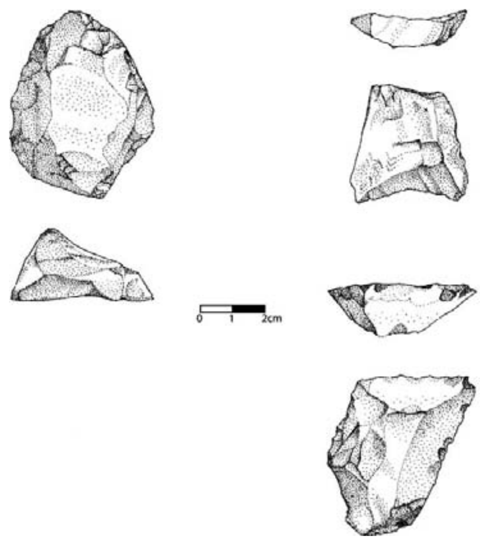


Figure 11.15. Miscellaneous unifacial flakes of the Las Pircas phase.

near Nanchoc in the sense of immediate availability that encouraged total expediency. Experiments with locally available materials revealed that removing flakes from streambed cobbles in the lateral quebradas is very difficult. Instead, reduced chunks were brought to the sites from boulder fields a few kilometers away. A small amount of nonlocal materials (silex and quartzes, ca. 1% of all raw material) is also present within the assemblages, but these materials may represent embedded procurement and not exchange with other groups (Rossen 1998: 259–260, Chapter 5). Furthermore, the quartzes likely derive from sources in the nearby quebradas Batán and Talambo, indicating a material linkage between the Zaña and Jequetepeque drainages.

Analysis of Las Pircas phase lithics from sites in the Q. del Batán and Q. Talambo similarly identified an expedient flake-based technology, but noted a more frequent presence of retouched flakes than in the nearby Nanchoc assemblages (Stackelbeck 2008). As with the Nanchoc lithics, those of the Q. del Batán and Q. Talambo areas during this phase were manufactured almost entirely from locally available quartz, quartzite, rhyolite, dacite, and basalt. The results of Stackelbeck's study indicate that retouched flakes were manufactured on a wider range of flake categories (e.g., core fragments, cortical flakes, interior flakes, and flake fragments) than were simple utilized flakes (which are primarily made on interior flakes and flake fragments) and were an intended end product (along with formal unifacial tools) of the lithic technology in the Batán-Talambo area (Stackelbeck 2008: 392–400).

Based on the results of these studies, we may expect to see a relatively wide range in the patterning, amount, and location of retouch on individual expedient tools – resulting in a number of distinct, recurring forms (Rossen 1991; Stackelbeck 2008). Retouched flakes are but one of several distinct expedient (and some curated) tool forms – including core tools and unmodified flakes – that characterize the Las Pircas lithic technology.

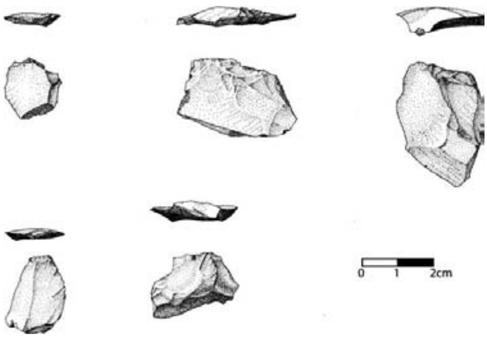


Figure 11.16. Miscellaneous unifacial flakes of the Tierra Blanca phase.

The specific kinds of flakes and debitage that were used in tool manufacture may also reflect important differences within an assemblage (Stackelbeck 2008). Because expedient tools are generally produced to fulfill specific, situational needs, larger numbers of tools are encountered on sites where wider ranges of activities were undertaken. High frequencies of specific kinds of expedient tools may be found on special purpose or task-oriented sites where specific sets of activities were repeatedly undertaken. On living sites, a wider variety of both expedient and curated tool types are present.

Tierra Blanca Phase

Tierra Blanca phase lithics represent a continuation of the expedient production that characterized the preceding Las Pircas phase. Flake tools (predominantly unmodified flakes) are the focus of the chipped-stone technology. Although similar to Las Pircas, the Tierra Blanca lithics do not display the regularity or internally consistent (including curated) forms that are observed in the Las Pircas tools and appear somewhat smaller, cruder, and more situational (Fig. 11.16; Rossen and Dillehay 1999). However, like the Las Pircas lithics, raw material use during the Tierra Blanca phase also relied heavily on locally procured stone, including andesite, basalt, rhyolite, and tuff. A few nonocal highland materials (silex and quartz) are present within Tierra Blanca assemblages indicating continued contact with and/or use of those zones.

There are, of course, other stone artifacts beyond chipped stone. Of these, groundstone is especially important, particularly regarding economic parameters and sedentism. The presence of these presumed agriculturally related tools, along with waisted hoes made of stone, is a reason we propose that the Las Pircas and Tierra Blanca people were gardeners and farmers even before we recovered macro-botanical remains (e.g., Dillehay et al. 1989). Although groundstone exists at El Palto sites, it is not as diverse and elaborate as it is at Las Pircas and Tierra Blanca sites (Fig. 11.17), often occurring in larger numbers as well. The groundstone is usually made of volcanic tuff, basalts, andesites, and rhyolites. Most are similar in sizes

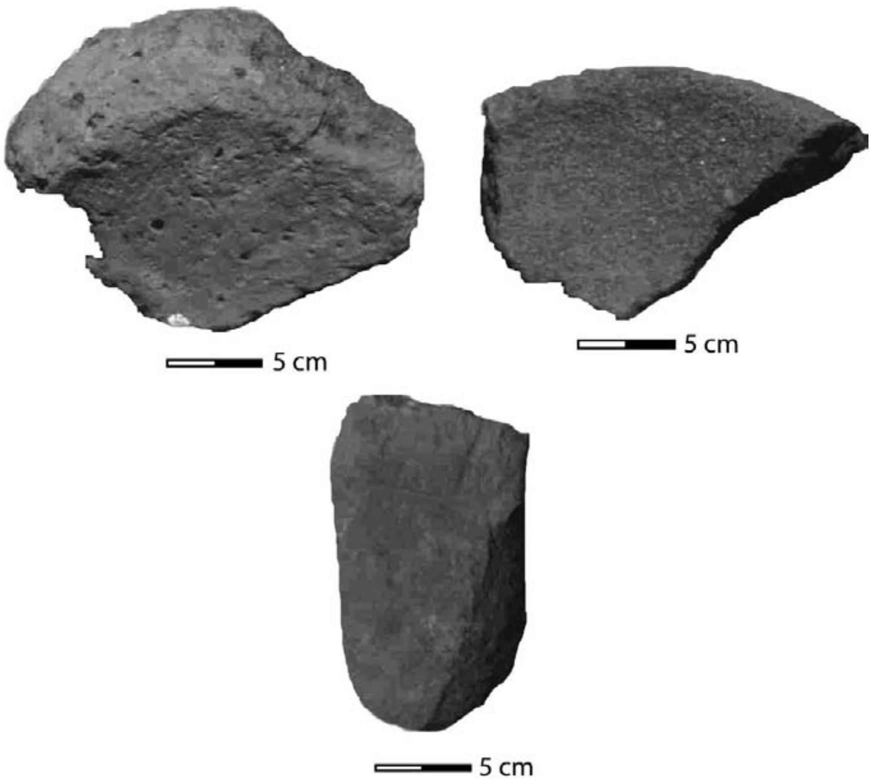


Figure 11.17. Grinding stone fragments from Las Pircas and Tierra Blanca phase sites. A rolling-pin mano from a Tierra Blanca phase site.

(i.e., 30 by 35 cm) and shapes, being amorphous to semi-rectangular in form and usually fractured.

Other significant stone implements are waisted hoes made of basalt and andesite. The prototype of these may be the angular chipped sodbusters that are found in Las Pircas phase sites (Maggard 2010). Waisted hoes are found almost exclusively on Tierra Blanca phase sites in the Nanchoc Valley and range in size between 14 and 20 cm in length and 8 and 12 cm in width, although a few examples are known from late Paiján and Las Pircas sites and from a few locales in Q. del Batán and Q. Talambo as well. Characteristically, they have a waisted or indented section near the proximal end which presumably served for hafting purposes (Fig. 11.18). The distal ends typically display steep retouch with crushing and/or hinge fractures indicative of striking moderately compacted to hard objects such as other stones and hardened clods of dirt. Hoes also are slightly convexed, presumably to produce a sharper and more effective striking angle.

Figure 11.18. Waisted hoes of the Tierra Blanca phase.

AFTERTHOUGHT

It is the material culture of the Las Pircas and the Tierra Blanca phases in the Nanchoc area that truly stands out from their El Palto precedents and their contemporaneous counterparts in other quebradas of the study area. However, lithics in the Nanchoc area are exceptional. With the exception of waisted hoes made of stone and grinding stones, the greatest variety and more advanced lithic technologies (e.g., Fishtail and Paiján points) occur in the lower elevated areas such as Q. del Batán and Q. Talambo. Grinding stones and small hand stones are present at lower elevated sites, but they are larger, more elaborate, and more frequent at the Nanchoc sites. Artifacts are not restricted to stone, as evidence by the two copper ornament pieces, shell and bone beads, modified shells, stingray spines, and other curiosities recovered from Las Pircas sites in the Nanchoc and Q. del Batán areas. A few tools made of bone and antler were found in Las Pircas and Tierra Blanca sites, but this type of industry is weakly represented in the study area. No evidence of artwork in the form of incision or rock art was recorded for the Preceramic period in the study area. Petroglyphs were found in the Espinal area of the middle Zaña Valley, but they appear to be of the later Formative era.

CHAPTER TWELVE

Settlement and Landscape Patterns

Tom D. Dillehay

A persistent topic in hunter-gatherer archaeological research has been evaluating the influence of environmental changes on past economies, technologies, and social organizations. Archaeologists have frequently employed cultural ecology as a conceptual perspective, interpreting cultural patterns in terms of adaptations to external environmental stimuli, or assuming that environmental patterns reflect the optimal patterns of hunter-gatherers within functionalist cultural systems in which social variables and cultural agents are minimized (e.g., Balter 2007; Kennett and Winterhalder 2006; Richerson and Boyd 2000). To situate social factors in relations between people rather than between people and environment, individual groups must be identifiable in the archaeological record. Burials and households usually offer the most scope for this, but excavated evidence needs to be more highly resolved in space and time for burial patterns than is the case for the Preceramic records of the Zaña and Jequetepeque valleys. The household data for the 8,000 year time span under study are reasonably good for inferring some social patterns. Nevertheless, many of the phenomena (e.g., technological innovations and economic decisions) and situations (e.g., culture contact and migration) that are most identifiable in the archaeological record are those related to human and environmental interaction.

Taking this interaction into consideration, I describe in this chapter the settlement data for the project area from the perspective of environmental conditions, resource structures and changing strategies, and when applicable, social relations. When these data are combined with other lines of evidence emanating from survey, subsequence testing and block excavation at selected sites, typological considerations, and frequencies of specimen and feature occurrence, they provide a strong case for site distribution changes and for an increase in population from late Pleistocene to middle

Holocene times. These data also reveal the development of diversified, or broad-spectrum, economies that are represented by maritime foragers and fishers along the coast and by co-existing intensive farmers and complex foragers in the interior by at least 8500 BP, all of which exploited multiple ecological zones. Discussed below are the settlement patterns that existed in each phase of occupation and why we think they existed.

We have argued for the presence of three major cultural phases in the study area: (1) a long-term mobile to semisedentary, broad-spectrum forager pattern on the arid plains near the coast and in the Carrizal delta of the abandoned late Pleistocene and early Holocene channel of the Zaña River; in selected quebrada interiors and adjacent alluvial fans of the Nanchoc Valley; and in the westernmost foothills, quebrada fans, and drainages of the Andes situated just east of the coastal plains in both the Zaña and Jequetepeque valleys, all termed most broadly the El Palto phase (~13800–9800 BP); (2) a sedentary forager and incipient farmer pattern of the Las Pircas phase (~9800–7800 BP), located in the Nanchoc Valley and less so in the quebradas of the lower and middle Zaña Valley, the Chamán Valley (i.e., Q. del Batán), and the lower Jequetepeque Valley (i.e., Q. Talambo, Q. Pitura, and Q. Güereque); and (3) sedentary fisher, forager, and farmer practices located in selected alluvial fans of the Nanchoc and Talambo areas, respectively, and dated to the Tierra Blanca phase (~7800–5000 BP). All sites in the Nanchoc Valley and most sites in other areas fit within these phases. Exceptions are 182 sites that could not be classified to any of these phases due to the absence of diagnostic artifacts and radiocarbon dates derived from the surface or from intact buried deposits. Several late and more sites of the Tierra Blanca phase with public spaces and architecture, including the Cementerio de Nanchoc site (CA-09–04) in the Nanchoc basin and Chical 1 (PV-19–15), Macauco 1 (PV-10–13), Viru (PV-19–20, PV-19–21), and Cerro Guitarra (PV-19–54) in the lower to middle Zaña Valley, are associated with sedentary farming groups practicing less hunting and collecting. The distinctions between all phases not only reflect patterns of sociocultural development but also have implications for human settlement and population dynamics.

For the purpose of discussion, I consider several major factors having affected human movement and settlement in the study area.

Paleoclimatic Shifts: As discussed in Chapter 3, there is evidence of changing paleoclimatic conditions from ~14000 to 5000 BP that affected human settlement and subsistence patterns. It is important to address how these changes might have altered the availability, location, and abundance of food resources in different ecological zones, especially plant foods. Given

the stacked but closely juxtaposed ecological zones in the study area that extend from the littoral to about 3300 masl, no single archaeologically recovered proxy record (i.e., pollen, stable isotope) from individual zones can be securely projected onto adjacent zones. Thus, all we can hope to do is to provide an averaged reconstruction of the paleoecology for each phase.

In brief, research by Weng et al. (2006) in the upper Jequetepeque and Pacasmayo watershed illustrates that deglaciation and warming began at least ~16,000 years ago and continued into the early Holocene period. Slightly cooler and wetter conditions developed between ~11,200 and 8,800 years ago. A slightly warmer and drier period appeared between ~8,800 and 5,300 years ago, with cooler and wetter conditions returning after 5000 BP (Weng et al. 2006). Research on regional temperature changes indicates that relatively moderate-elevation ecotones in the west central Andes (~300–1,000 masl), such as the forested upper middle Zaña and Nanchoc area, may well have undergone changes in mean temperature, precipitation, and habitat, especially between ~9,000 and 5,500 years ago when warm and dry conditions increased for the coastal plains and nearby foothills of the Andes. However, as noted by Netherly in Chapter 3, the presence of dry forest faunal remains, including boa, the *tinamou* bird, iguana, and *jaguarundi* – especially along with *Coleoptera* beetle larvae casts within intact strata dated to the Las Pircas and Tierrra Blanca phases (~9800–5000 BP) in the Nanchoc Valley – suggest seasonal forest conditions for this period (see Chapters 9 and 10). On the whole, dry conditions are advantageous for root plants, in that this establishes open areas for neophytes. Conversely, humid conditions increase forest cover, probably closing off open terrains that contain neophytes.

Current evidence also indicates that during the periods of study there has been considerable variation in the frequency and predictability of various key plant food resources, especially cacti, *algarrobo*, fruits, and tubers in the drier quebrada fans of the lower Andean foothills and coastal plains. The plant communities become much more diversified and abundant as one moves from the plains into higher elevations along the heavier vegetated drainages of the Zaña, Nanchoc, Chamán, and Jequetepeque rivers, depending upon the environmental setting encountered. This also implies that different elevations and plant communities within this transition zone were impacted differently by changing climatic conditions (see Chapter 3). An excellent example of this transition is found along the lower to upper reaches of the Nanchoc River drainage, where the ecology shifts from a dry thorn forest to a more humid seasonal forest to a humid forest

within a 15 km distance. This drainage also was associated with small lateral streams manageable for irrigation farming. Moving south up the drainage from the valley floor today, one enters heavily dissected alluvial fans and an impressive diversity of plant life, including dense assortments of *palo santo*, *ebano*, *faique*, *algarrobo*, and other woody species mixed with grasses. Attendant to this change in vegetation patterns is a change in the character of archaeological sites – from the large lithic scatters and hearths fields, rectangular house structures, and irrigation canals and agricultural fields situated near the edges of alluvial fans and dated in the Tierra Blanca phase to the slightly smaller lithic scatters, campsites, garden plots, and circular house structures of the earlier Las Pircas phase in the upper reaches of the fans. Similar, if sometimes less dramatic, examples of changes in site character attendant to elevational and biotic transitions occur in the middle Zaña and Chamán river basins (e.g., Q. Despoblado, Q. del Batán, Q. Talambo), in the more easterly areas of the upper Nanchoc (Bolivar) and Chamán (Carahuasi) valleys, and in the Q. Cupisnique, Q. de la Pampa Pitura, and Q. de la Pampa del Güereque on the south bank of the Jequetepeque River (Fig. 1.2).

Undoubtedly, as climates changed through time, the different habitats intermittently shifted downslope and upslope depending upon temperature, humidity, and sunlight conditions (see Chapter 3). The location and density of terrestrial faunal species also must have varied according to the shifting vegetation patterns described earlier. Major terrestrial species exploited during all periods would have been deer, iguana, peccary, armadillo, large rodents, snakes, *jaguarundi*, and birds. Along the coast, various birds, fish and shellfish, and sea lions were exploited.

Resource Planning. Although there are few seasonal changes in the study area in terms of temperature, there are marked shifts in precipitation rates and elevations that would have affected vegetation growth and availability. In many ways December through April, the rainy season in the highlands, represents the major period of subsistence resources for immediate consumption in the middle and upper valleys of the study area. Along the foothills and the coastal plains, it is May through September when the *garua* or fog belt provides moisture sufficient for vegetation to grow in the *lomas* of the hills and grassy areas along the coast. Storage plant resources (e.g., tubers) possibly served as one of the critical recovery foods during the dry months from November to March along the coast. The dry and humid forests of the Nanchoc basin and upper Zaña Valley would have provided the most diverse and abundant resources throughout the year. The subtropical climate and environment of the study area would

also have permitted annual multi-cropping. Agricultural crops can be and are grown in all zones where freshwater wetlands or water for irrigated fields is available.

Variation in the resource structures of biotic communities from the coast and desert plains to the higher elevated dry to humid montane forests certainly influenced local variations in the subsistence-settlement strategies of foragers and early farmers. In the eastern part of the region, the humid forest and, to a lesser extent, the lower, seasonally dry forest have relatively low primary productivity of wild plants but high secondary biomass and high species diversity (see Chapter 3). Dominated by low shrubs and grasses, the coastal plains have relatively low primary productivity, medium secondary biomass, low species diversity, and more uniform distribution of species across the landscape. Thus, in the plains there is a gradient from west to east and from sea level to 1,500 masl of increasing seasonality, species diversity and abundance, secondary biomass, forested vegetation, and resource patchiness. The far western edge of the study area is characterized by one of the world's richest maritime zones, as well as productive brackish water estuaries and wetlands.

The study area experienced some degree of population-resource imbalance in some environmental zones during all cultural phases, meaning that some areas with relatively abundant water and wild food resources were occupied more heavily than others. Holding site visibility aside, this is reflected in the presence of fewer and smaller sites in some areas along the coastline and coastal plains during all phases, as well as a few quebrada fans in the lower foothills of the Andes where there may have been fewer water resources. This implies choices made by groups to deliberately aggregate in certain areas where water and natural food resources were more abundant, perhaps even during any times of resource stress such as a drier period between ~9000 and 6000 BP for the lower parts of the study area. (Resource stress implies depletion of food and/or water sources due to population pressure on them and/or to changing environmental conditions such as aridity that lead to a reduction in plant and animal food sources.) Yet some resource-rich forested quebradas in the Nanchoc Valley were densely populated while other equally suitable quebradas were not, suggesting that climatic and environmental conditions were not the only factors influencing the settlement patterns through time and space.

Chronology: The chronological data of each phase discussed in Chapter 1 appear to reflect some past dynamics. First, populations appear to have increased and declined twice in the past ~13,000 years, presuming there are no major sampling errors in the database. This pattern appears to correlate

with the emergence and then slight decrease of aggregated households during the late Las Pircas phase (~8500–7800 BP) and most abruptly during the terminal Tierra Blanca phase (~5500–5000 BP) when household sites and public places, such as the Cementerio de Nanchoc site, and irrigation canals were abandoned, and when local populations were increasing and moving to larger tracts of agricultural land farther downvalley in the middle and lower Zaña Valley. This pattern is less evident in the Q. del Batán and Q. Talambo and the Jequetepeque Valley in general, which appear to have been utilized invariably throughout all time periods, although very few classic Las Pircas- and Tierra Blanca–site types are present in these areas.

The second problem concerns abandonment, which we consider to mean residentially unoccupied but economically exploited quebradas. Curiously, near to total abandonment of many parts of the study area (especially the lateral quebradas that once served as foraging areas) occurred between ~5500 and 5000 BP, a time when the climate was becoming wetter and warmer and presumably more favorable for agricultural production. Exceptions are along the coastline near the deltas of the rivers and perhaps in large expansive quebrada fans near the lower valley floors such as Q. Talambo. We argue that abandonment was associated with a combination of population increase and resource pressure in certain habitats, and the need for more extensive fertile lands, which may have opened middle and lower valley fertile areas to an influx of populations from the upper middle valley and smaller inland quebrada fans located closer to the desert plains (Dillehay et al. 1989), bringing new adaptations (namely, a larger and more widespread farming system). Another reason may have been social aggregation and social conflict, especially in the Nanchoc area.

Scale of Communities: The scale of communities also is a significant factor in subsistence and settlement systems. Simply put, more people aggregating in one area require collection and/or production of food from a greater geographical area, which results in a wider collecting radius or the adoption or innovation of technologies (i.e., agriculture, storage facilities, irrigation canals) to increase and intensify food production. We suspect that with the reduced availability of plant and animal resources in some habitats, other than the forested Nanchoc basin, between ~9000 and 6000 BP some communities became hard-pressed to meet their subsistence needs and that this eventually contributed to the dispersal of some people into smaller communities. Yet, on the other hand, there are communities that apparently deliberately aggregated between 9000 and 6000 BP in the Nanchoc area

in a dispersed or pseudo-dense pattern (Rossen 1991). By at least 6000 BP, people in the Nanchoc Valley turned to irrigation agriculture for increased food production. In this case, resource imbalances and environmental stress seem not to be major factors promoting the transition to agriculture in this small mid-slope dry forested valley.

Social Issues: Some changes in social structure during all periods can be seen in the size, internal site structure, features, burial patterns, artifact contents, and settlement patterns of sites. The appearance of articulated human burials, disarticulated human bones placed in pits, possible cannibalism in the form of cut and burned bones in the Las Pircas and, to a lesser extent, Tierra Blanca phases suggest social and group differentiation (and conflict?); and the aggregation of single-room circular houses in some areas in the late Las Pircas phase and the appearance of multiroom rectangular houses in the Tierra Blanca phase indicate that social changes were taking place. Further, the low frequency of sites in some areas and high frequency in others indicate choices made by groups to socially aggregate or disaggregate their settlements. The reasons for these choices probably include social, environmental, and economic factors. A combination of social and ideological factors probably accounts for patterning in the deposition of human bone remains, for the placement of rock crystals in furrowed garden plots at Las Pircas house sites and later in the two mounds at the Cementerio de Nanchoc site, and for the building and ritual carried out at these mounds. The mounds have a specific location and that location would have been meaningful in a variety of social and ideological ways to the people who built and used them. The same meaning and function probably applies to the Preceramic mounds at Macuaco 1 and Viru in the middle Zaña Valley, although these sites have not been extensively studied and less is known about them.

In sum, the ecological diversity of the study area led to an economic diversification inherited from three convergent strategies: traditional broad-spectrum foraging by local groups in various closely juxtaposed resource zones; exchange of local resources with neighboring groups for exotic resources during the Las Pircas phase and possibly earlier; and cultural influences such as irrigation technology and cultigens received from distant groups. However, the settlement and subsistence patterns cannot be interpreted simply in regard to their obvious economic and environmental adaptive connotations: they also reflect ideologies, social differences, and negotiations between those ways of life that constituted the basic options that were available.

SPATIAL VARIABILITY AND PHASE ADAPTATIONS

In terms of El Palto and early Las Pircas phase hunting and gathering practices, site locations and characteristics suggest that the ecological gradient from the coastal plains to the semi-arid and dry forests led to a collector (logistical mobility) pattern in the Q. del Batán and Q. Talambo (Stackelbeck 2008; Maggard 2010), and a forager (residential mobility) pattern in higher elevated and forested quebradas farther east during the El Palto phase. Although hard evidence for subsistence and domestic characteristics in many areas is lacking due to the superficial nature of many sites, the terminal Pleistocene Amotape-like lithic assemblages located in the delta of the Carrizal drainage probably was associated with an economy focused on wetland and estuary resources along the coast, probably with occasional forays into the interior for knappable raw materials and other resources. Fishtail sites are located primarily in the circumscribed area of the upper Q. del Batán, where several springs and a subtropical thorn forest existed in the past, a pattern similar to that described by Briceño (1995) for Fishtail sites in the Santa Maria quebrada on the north side of the Chicama Valley to the south. The presence of Fishtail points in these areas may suggests the presence of more active springs and the centralized location of the zone between the coast and highlands. Paiján sites of the El Palto phase occur in nearly all settings except for the dry forest and humid forest (which may reflect problems of archaeological visibility due to heavy vegetation cover) and the desert plains and coastline. Late Paiján sites are often associated with early house structures near small drainages dissecting alluvial fans at the interface between the eastern coastal plains and the foothills of the Andes between 50 and 200 masl. These sites probably represent transitional logistical foragers to incipient gardeners partly dependent upon domesticated squash for food staples. Across the region, a dual-zone pattern of settlement was practiced during the late Pleistocene and early Holocene periods, with both logistical and residential sites concentrated in the coastal plain and lower quebrada settings, such as Carrizal and Q. Talambo, Q. Cupisnique and Q. Pitura/Güereque and on upper alluvial fans in the Nanchoc basin and Q. del Batán. In the Las Pircas area, most multiple-activity, residential sites of the early Las Pircas phase were located in the upper quebradas. In other basins of the study area, some multiple-activity sites were located on terraces overlooking stream bottoms; but the largest ones were on middle and upper alluvial fans.

Surprisingly absent in the settlement patterns of the El Palto and Las Pircas phases are littoral sites. This is surely due to now submerged coastlines

and wetlands. The littoral zone offered a greater abundance and diversity and thus perhaps a greater degree of security against resource stress. Inhabitants of the inland coastal plains and foothills within reach of the littoral also depended on marine resources for a portion of their diet. The presence of small amounts of marine shell in the Las Pircas phase sites of the Nanchoc basin and the bone remains of brackish water fish (i.e., mullet) at late El Palto phase sites in the Q. del Batán and Q. Talambo indicate that the ancient shoreline was exploited as far back as 12000 to 9000 BP when the sea level was farther west than it is today (Rossen 1991; Maggard 2010; Stackelbeck 2008). Resources like seabirds and their eggs, crustacea, sea mammals including different kinds of whales and sea lions, and fish with a wide range of habitats and breeding seasons were not merely diverse in character and accessibility but offered a range of year-round foods that together with inland resources were capable of being combined in an intricate scheduling of seasonal harvests, as well as affording reserves for times of stress in the form of mollusks, limited in bulk yet having the advantage of being always available.

The scarcity of littoral sites does not imply an absence of coastal activity because sites PV-19–23 and PV-19–60 reveal occupations near 7,200 years ago, indicating that portions of the seashore surveyed today were present for at least the past 7,500 years. We also suspect that some coastal sites are buried under paleo-dune formations and thus are invisible to archaeological survey. These are patterns that require more investigation in the future.

The early agricultural landscape in the Nanchoc Valley during the late Las Pircas and subsequent Tierra Blanca phases was also composed of a diverse range of niches. Early cultivation techniques that have been identified or inferred in this region include shallow ditch gardening by households by at least 9000 BP at domestic sites in the middle and upper Q. Las Pircas (Rossen 1991) and multi-household irrigated farming by at least 6500–6000 BP at Tierra Blanca sites near the valley floor (Dillehay et al. 2007); these techniques were different in terms of productivities, risks, labor requirements, and energy efficiencies. Based on current evidence the only other place outside of the Nanchoc Valley where early agriculture might have been practiced was in the Q. Talambo area during the Tierra Blanca phase, and this is suggested by the presence of canal ditches and grinding stones at two sites (Stackelbeck 2008) and a few stone hoes at others. However, no macro- or micro- remains of cultigens were recovered from excavations at these and other sites in the area (Stackelbeck 2008; Maggard 2010), though other edible plant evidence was recovered (i.e., cactus fruit and leaves, *algarrobo* pods).

SPECIFIC SITE AND PHASE DISTRIBUTIONS

Although there are several subareas for which we have few or no site data, extensive archaeological surveys carried out in the study area have generated a workable database for settlement and subsistence system analyses. As noted in earlier chapters, complete 100 percent survey was carried out in the lower Jequetepeque Valley between 1997 and 2008, and about 70 percent survey was conducted in the lower to upper Zaña Valley intermittently between 1977 and 1997. Specifically, the north side of the Zaña Valley between the coast and Cerro Songoy and the quebrada fans southeast of Nueva Arica were only partially surveyed. The smaller quebradas, mountain slopes, and upland areas between Pan de Azucar to Hacienda Monteseco on the north side of the middle upper Zaña Valley and the La Toma area of the highland plateau between the middle upper Zaña and Nanchoc valleys also were only partially surveyed. (Partial survey in these areas was carried out between 1984 and 1992 when survey teams had security problems and difficulties in accessing lands during the *sendero iluminoso* civil war in Peru.) The entire coastline between the north shore of the Zaña Valley and Puemape was surveyed.

In areas where ceramic settlement and agricultural systems were developed extensively and many sites subsequently destroyed, such as the irrigated lands between Chepen, Guadalupe, Cerro Pitura, and Ciudad de Dios in the lower Jequetepeque Valley, no Preceramic sites were recorded, although unifacial tools and other lithic debris were occasionally recovered from the surface of these areas. This pattern also occurs in the vast *yardang* areas west of Canoncillo and Jatanca on the north side of the Cupisnique drainage, in the Pitura and Guerreque pampas southeast of Cañonillo, in the extensive desert pampa east and north of Pacatnamu, and in many areas south of the Talambo hacienda also in the Jequetepeque Valley. In the Zaña Valley, the valley floor from the coastal hills of Purulén to the vegetated Pampa of Oyotun and Nueva Arica in the middle valley and the Cerro Corbacho and Cayalti in the lower valley are affected similarly.

Based on the analysis of the spatio-temporal variation of site frequencies, site sizes, locations, and estimated functions, we examined settlement patterns according to the distribution of sites across the landscape. Figures 12.1 through 12.3 present site distributions by each phase for the study area. Figure 12.1 shows that the earliest sites tend to be concentrated in the quebradas of the foothills of the Andes between elevation zones of 500 to 800 masl. These zones encompass the desert steppe to the seasonally dry forest in the Nanchoc Valley. More sites of each phase are presented

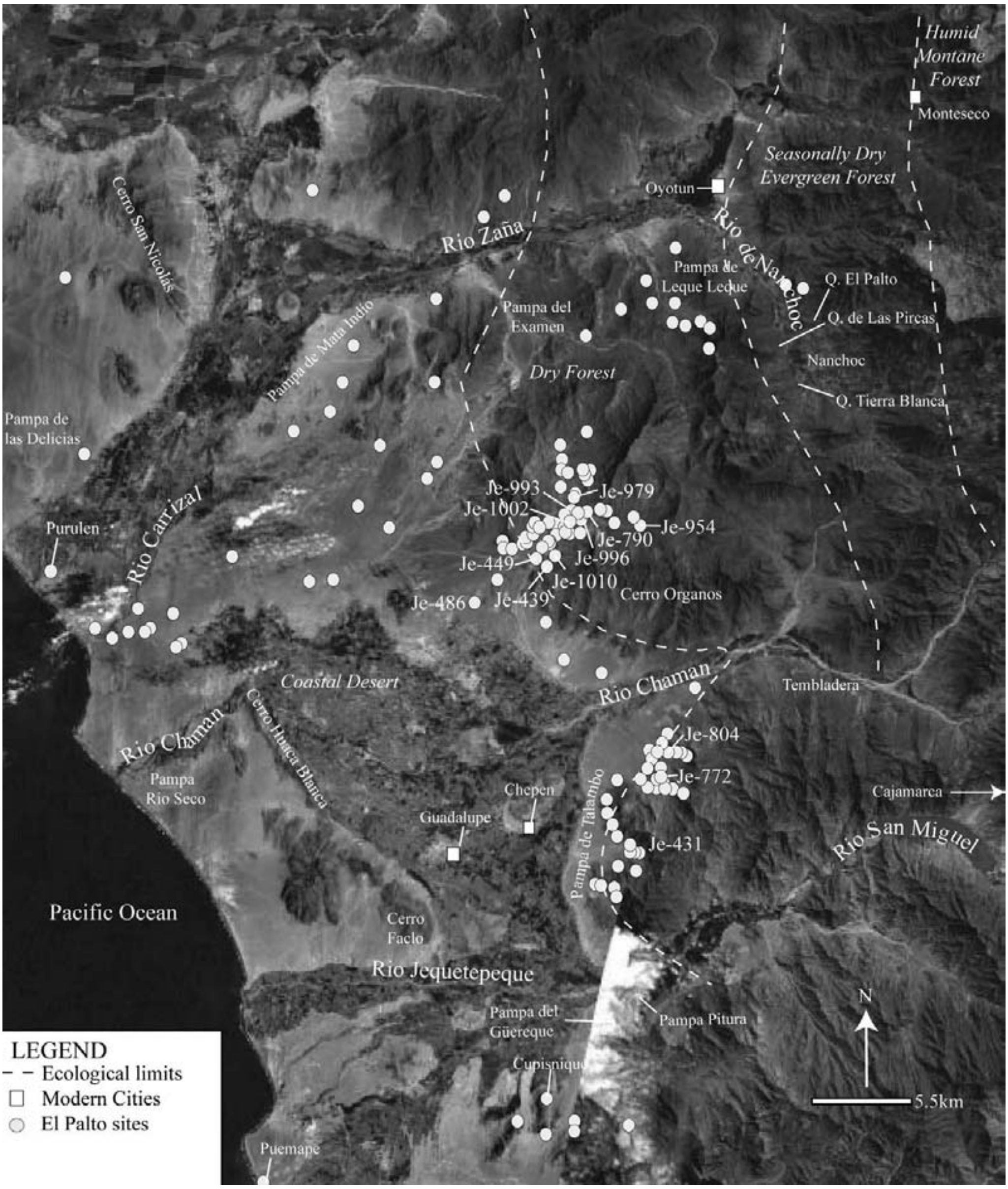


Figure 12.1. Location of El Palto phase sites in the study area.

by the indeterminate category. Based on the location and size of many indeterminate localities, we estimate that many of them are late Paiján and Las Pircas sites or places where occupants of all periods exploited the local landscape, especially in cases whereby the site is a large palimpsest of many different occupations. In cases where the sites are small and located near the edge of the alluvial fan just above the valley floor, they may be of the Tierra Blanca phase, but excavation is required to verify this supposition.

El Palto Phase: A total of 113 sites were recorded in the study area. Figure 12.1 shows that early sites cluster in three areas: the Q. Examen and Pampa de Mata Indios and the Carrizal drainage in the middle and lower Zaña Valley, the upper reaches of lateral drainages in the Q. del Batán and Q. Talambo, and the entrance to the Q. Cupisnique from the north. (More sites dating to the El Palto phase have been recorded by Chauchat [1988] in the Q. Cupisnique.) Other El Palto sites are scattered lightly across the desert pampa of the south bank of the Zaña Valley and in other lateral quebradas in the lower Zaña and Jequetepeque valleys. Sites located in the Carrizal area probably are associated with now submerged ancient wetlands just off shore of the present-day coastline in the ancient delta of the Zaña Valley. Most sites are short-term campsites, processing stations, and quarry sites, the last located primarily in the entrance to the Q. Cupisnique just south of the Q. Güereque. All Fishtail sites are located in the Q. del Batán; both early and late Paiján sites are scattered across nearly all areas but primarily located in quebradas where active springs exist in the lower foothills of the Andes. The majority of the Paiján sites were located in the mouths of expansive alluvial fans in the Q. del Batán, Q. Talambo, and Q. Cupisnique. No Paiján points or lithics were located within a 10 to 11 km distance of the present-day coastline. No diagnostic El Palto sites were located in the present-day fertile floodplains and adjacent cultivated lands of the two valleys, either because they were not preferred areas of occupation or, more likely, sites have been destroyed by modern-day activity.

Las Pircas Phase: A total of forty-eight sites were found for this phase. Sites of this phase are concentrated in two localities: the Q. Las Pircas on the south side of the Nanchoc Valley and in an unnamed quebrada on the north side of the lower middle Zaña Valley (Fig. 12.2). Both areas are associated with once active springs located in the upper reaches of the quebradas, as indicated by visible travertine deposits. A few Las Pircas sites were located in the Q. del Batán and Q. Talambo, and it is likely that more exist but no diagnostic architecture or lithics were associated for phase identification. Several indeterminate sites located on the south side of the lower Zaña Valley exhibited small circular structures (ca. 2.3 m in diameter) associated with a few grinding stones. Although no intact floors, diagnostic lithics, or features (e.g., storage bins, garden furrows) were found in these structures, the presence of unifacial flake scatters are reminiscent of Las Pircas sites.

The hallmark of the community pattern of this phase in the Nanchoc basin is the individual household site associated with "dooryard" or kitchen gardens. As discussed in Chapter 5, these sites are located primarily on

Figure 12.2. Location of Las Pircas phase sites in the study area.

the alluvial fans on the south side of the basin and are generally separated by a few hundred meters. Small gardens were scattered on relatively level patches of land surrounding house sites. A much larger zone around these houses must have been used for less intensive purposes – hunting and gathering. Because squash, peanut, quinoa-like chenopods, tubers, and other crops of the period would have yielded more food per hectare than wild resources, house gardens were much smaller than surrounding foraging

areas in the dry forest. The latter area was significant for many dispersed or patchy complementary resources – game, berries, tubers, snails, and so forth. Such a pattern included both economic intensification in the form of the house gardens and "extensification" (McCorriston 1997) of resource procurement in the form of the surrounding foraging zone.

Tierra Blanca Phase: Forty-two Tierra Blanca sites in the Nanchoc basin are long-term, multi-room rectangular domestic structures that are not associated with individual house gardens but with middens and communal agricultural fields and irrigation canals (Fig. 12.3). In areas outside of the basin, some sites exhibit rectangular houses and are associated with canals (i.e., Q. Talambo); others show no architecture and agricultural features but radiocarbon date to or contain dated diagnostic lithics of this phase (see Chapter 6). The Tierra Blanca phase sites are concentrated in two areas: the south side of the Nanchoc Valley and, to a lesser extent, the middle Zaña Valley near Chical 1 and Macauco 1. A few sites are located in the quebrada on the north side of the lower Zaña Valley and in the Q. Talambo. All of these sites are situated near the edge of the quebrada fans close to active springs, the valley floor, and irrigation canals. In the Monteseco and Espinal areas, a few Tierra Blanca sites are located along terraces of large streams descending from the highlands above. Although no canals were found in these humid forest areas, we suspect that the flat lands adjacent to the streams were used for crop production. At the end of the Tierra Blanca phase, the Nanchoc area is largely abandoned as a likely result of populations moving to the middle and lower valley sectors to access more extensive and fertile soils.

GENERAL PATTERNS

The most obvious settlement trend in the study area is related to low and high frequencies of sites on heavily dissected alluvial fans in side quebradas and near water sources (i.e., springs and secondary streams). With few exceptions, evidence of Las Pircas and Tierra Blanca phase occupations can be found in or on most suitable landforms and in most water courses in the area, including the floors of the warmest, driest drainage basins to the tops of the dry thorn shrub- and forest-clad hill slopes up to 1,200 masl. Usually, Las Pircas sites are found in the higher elevated areas of the quebradas and Tierra Blanca sites in the lower elevations. In terms of site density, the forested foothill zones of the region's mountain ranges, especially those between the Zaña and Chamán valleys, with their rich assortment of flora and fauna and sources of springs and knappable stone,

Figure 12.3. Location of Tierra Blanca phase sites in the study area.

were favored by early foragers of the El Palto and early Las Pircas phases for habitation. Las Pircas phase sites are almost as common as Tierra Blanca phase sites. They are found in a wide variety of habitats, including what are now dry forest drainages and alluvial fans, around landform anomalies (such as isolated and free-standing bedrock outcrops or eroded hill remnants) in the quebrada basins, on low ridge and mesa tops, in saddles and on slope hillsteps (small, level step-like areas that occur on the talus slopes

of low hills), in rare rock shelters in the faces of a few bluffs (e.g., near Chumbenique on the north bank of the Zaña River), in boulder falls (also in Chumbenique and in the Q. Portachuelo and Q. del Batán in the lower Jequetepeque Valley), on high elevation mesa lands (e.g., Niepos), and in naturally sheltered niches on the tops of hills and pinnacles often at long distances from water sources (both then and now). Probably, many of these sites represent special activities, such as plant collecting, stone tool procurement, and, at least in the case of some hill and mountain top sites, possibly ritual behavior, although there is no clear evidence for the latter.

Not all quebrada fans and drainages were continuously occupied, especially in the Las Pircas and Tierra Blanca phases. Regardless of how we view the issue of regional occupational continuity, the majority of dispersed small house structures (<2 m in diameter) in the areas from ~10800 to 9800 BP (the late Paiján phase) do not appear to have been occupied as extensively (considering the frequency and physical spacing of proto-households within any area, as well as the thickness of floors suggestive of long, intensive use) and the area did not have the large more aggregated households (>2 m in diameter) as was the case during the succeeding 9800–5000 years BP (Las Pircas and Tierra Blanca phases).

We believe that there were a number of interrelated factors involved in the shift from widely dispersed households, with a moderate density of small houses in single or multiple locations – such as the Las Pircas phase sites in Nanchoc and Cerro San Nicolas in the Zaña Valley and Q. Talambo in the Jequetepeque Valley – to more aggregated household communities of a limited number of people living in larger houses, such as Q. Tierra Blanca and Q. Sin Nombre (QSN) in the Nanchoc basin. These include an increased reliance on both the seasonally dry forest and the humid montane forest resources within aggregated agricultural communities of ~7800–5000 BP; an intensification in the use of faunal and crop resources; and, toward the end of this time span, an increase in the scale of these communities, a decrease to disappearance in the number of exotic materials, the appearance of public mounds at site CA-09–04, and perhaps a reduction in the availability and predictability of wild plant food resources. As noted previously, members of the later Tierra Blanca phase communities were focused more on lower quebrada and probably floodplain resources and especially on crop production on nearby terrace benches of the south Nanchoc Valley. Recent evidence also suggests an expansion of the role of *algarrobo*, snails, cactus, and possibly food crops in the diets of inhabitants of Q. Talambo and Q. del Batán (Stackelbeck 2008) during this phase.

Las Pircas populations commonly occupied and reoccupied basin/quebrada/foothill sites, but they also expanded into ecological niches for the most part ignored by El Palto, terminal Preceramic, and later ceramic inhabitants. These include basin anomalies such as restricted but visible outcropping bedrock and/or isolated paleo-dune formations in otherwise homogeneous basin and quebrada environments, slope hillsteps, and the tops of low mountain peaks. A good example, a quebrada anomaly site (JE-356), occurs on paleo-dunes near a large, presently inactive stream on the southeast side of the Q. Pitura in the lower Jequetepeque Valley. A second example is site CA-09–87, a utilized quartzite outcrop at the top of the Q. Las Pircas (Rossen 1991: 93). Preceramic components that have middens like scattered burned rock and lithics also are found in protected niches on the tops of low hills and are sometimes suggestive of specialized resource procurement.

Current knowledge of Tierra Blanca phase activities is limited to sites located in a single type of landscape setting – by streams dissecting alluvial fans on the south side of the Nanchoc River and along a few streams in the Q. Talambo area. To date, limited excavations have been conducted at seven sites in the Nanchoc area and at eight sites in the Q. del Batán and Talambo with occupations assignable to the Tierra Blanca phase by a combination of radiocarbon dating, evidence of architecture, and material culture traits. All of these are buried in alluvial landforms in dry forested zones below 500 m in elevation. Some short-term campsites in quebrada and foothill settings at elevations of up to 500 m have yielded mostly El Palto, Paiján, and early Las Pircas sites, but only two (CA-09–81, CA-09–82) have been excavated. The functions of those sites in the Q. del Batán and Q. Talambo, and their relationships to the large but dispersed settlements in forested zones, are little known but suggest temporary hunting-gathering stations (Maggard 2010; Stackelbeck 2008). The same observations can be made about the lack of detailed knowledge of landscape use outside of riverine zones and in the desert plains near the coast – for instance, the Pampa de Las Delicias north of the middle Zaña Valley and the Puemape area along the coast south of the Jequetepeque River.

Bluff and particularly boulder-fall rock shelters are found infrequently throughout the study area, sometimes reaching 10 m in length and 15 m in width (i.e., drip line to back wall). One fallen boulder at Chumbenique on the north bank of the Zaña River was ~21 m high and had an occupational circumference around its base of ~85 m. Test excavations at this site by Dillehay, Rossen, and Peter Kaulicke in 1992 yielded Formative and late

Preceramic occupational debris. Maggard (2010) also excavated a boulder shelter (JE-1002) in the middle Q. del Batán that yielded early lithics, fragments of human remains, and a late Pleistocene radiocarbon date.

In addition to open campsites, a wide range of special activity sites in all areas can, with some confidence, be attributed to Preceramic populations. Stone tool sources such as Cerro Guitarra on the north side of the lower Zaña Valley, Cerro San José in the Jequetepeque Valley, Cerro Chilco and the Q. Cupisnique south of the Jequetepeque Valley, and a host of extensive quartzite outcrops in and around the entrance to the Q. Cupisnique and at the top of Q. de Las Pircas attracted people through time; innumerable knapping stations and short-term campsites – many inferred to be of early to late Preceramic affiliation – are found on and in the near vicinity of such outcrops. Chalcedony, jasper, and silex are raw materials found in the higher elevations of the study area (>1200 m) and thus represent exotic materials.

The impact of glacial outwash on archaeological landscapes in the study area is not well understood, though it is probable that any early sites once located on the valley floors were destroyed. There also is some evidence that earlier evidence is lost by outwash. Three 20 m high mesas or *yardangs* in the vicinity of Cerro Gávilan in the lower Zaña Valley exhibit dark desert varnish and contain surface flakes of the same varnish (see Chapter 4). The flakes are large primary and secondary flakes of the Siches and Amotape styles (Rossen and Dillehay 1999). The presence of these flakes on these remnant landscapes suggests that much of the late Pleistocene valley floor and any artifacts on it were probably washed out sometime before 10000 BP.

INTACT BURIED CULTURAL DEPOSITS

Since the inception of the Zaña and Jequetepeque projects, we have made a point of locating and examining buried cultural deposits that are exposed in drainage cuts. The primary objective of this work has been to continue expanding the database begun in the mid-1970s by Dillehay and Netherly (Netherly and Dillehay 1985, 1986a; Dillehay et al. 1989) concerning the recognition of archaeological-geographical relationships and to obtain associated bulk carbon and charcoal samples from such buried deposits for radiocarbon assay. While substantial buried early to middle Holocene deposits occur in terraces along the mainstream of the Nanchoc River, this pattern of occupation is not necessarily repeated along all drainages in the study area. The deeper and more substantial deposits tend to be located away from the main stem of the rivers and situated near streams dissecting

alluvial fans flanking the valley floors, possibly due to the dynamic and unpredictable nature of the rivers; due to preference for higher areas to avoid heavy vegetation, flooding, and pathogens in the valley floor; or due to extensive lateral cutting by streams and modern agricultural activity that has removed some of the archaeological evidence.

Campsites containing the stratigraphically deepest (sometimes exceeding 50 cm) and/or thickest deposits most often occur on drainage terraces adjacent to springs in the foothill environments and along deeply incised basin drainage systems (e.g., Q. Examen, Q. Talambo, and Q. del Batán). When available, landforms suitable for camping immediately at or close to springs were invariably occupied. In the absence of springs, water-retaining natural basins in the upper reaches of some quebradas (Q. del Batán, Q. Pitura) or in bedrock were often the focus of settlements. Although often spatially restricted by the physical size of available landforms, such open campsites – even when quite small in horizontal extent (~200 m^2) – frequently contain moderately thick middle Holocene midden deposits (~25–40 cm) characterized by carbon-laden soils, burned rock, some preserved faunal material, high to low densities of debitage and snapped tools, and occasional ground stone implements, including manos, metates, and rarely bedrock mortars. Minor test excavations and shovel tests carried out at a number of such sites throughout the study area unfortunately suggest a rather high propensity for deflated and/or temporally mixed deposits due to bioturbation, wind erosion, and colluvial dynamics (Dillehay et al. 2004; Stackelbeck 2008; Maggard 2010). As might be expected, the preservation of perishable artifacts and plant macro-fossils, as well as pollen, starch grains, and phytoliths, in open quebrada and foothill campsites is variable but tends to be poor.

Quebrada fans and basin drainage systems and their tributaries were the primary focal points of all Preceramic occupation, but the character and intactness of these components along drainages can be quite different from that of foothill and lower elevated spring sites. Rough broken terrain forming the valley walls of the low basin drainages, especially in the Q. Examen and Q. del Batán, often yields evidence of small, activity-specific sites – probably related to plant collecting/food processing – and are suspected to be primarily Las Pircas and Tierra Blanca phases in age, as suggested by diagnostic unifacial lithics and structures. In the lowest desert basins of the Q. del Batán, Q. Talambo, and Q. Examen, open campsites of the El Palto phase occur both on deflated ground surfaces and in buried contexts where they are exposed in eroded drainage walls. The buried deposits in these settings tend to consist of thin, sometimes stratified midden soils

containing scatters of burned rock, lithic debitage and tools, and less frequently hearths. Remnants of some stone-lined living structures also are present (see Chapters 4–7).

POPULATION DYNAMICS AND ESTIMATES

Using archaeological data to reconstruct changes in population structure is a complicated process. In this section, we briefly examine changes in the frequency, distribution, size, and internal structure of sites to reveal any possible changes in population density in the study areas. Caution must be exercised in addressing this issue, because increases in the frequency and size of sites could reflect an increasing intensity of food exploitation, site reuse and reoccupation, and other activities, but not necessarily a population increase. Rough estimates of population densities for each phase also are given, although this is difficult to derive because the number of contemporaneously occupied sites at any one time and how many people lived in each site are unknown. Further complicating the matter is that some sites, especially those in the Q. del Batán and Q. Talambo (see Stackelbeck 2008; Maggard 2010) but less so in the Nanchoc Valley, were reoccupied multiple times, which has expanded site sizes and may give the impression of a large single component locality (see Chauchat et al. 2006). Hypothetically, higher site frequencies should represent higher population densities, but, as discussed later, that is not always the case. The highest density of occupied sites corresponds to the south bank of the Nanchoc drainage and along streams of Q. del Batán and Q. Talambo during the Tierra Blanca phase, with relatively lower densities during the earlier Las Pircas phase and even lower ones during the earlier El Plato phase, with the exception of a higher density of sites in the Q. del Batán and Q. Talambo. The settlement pattern data suggest generally low populations for most areas during the El Palto and early Las Pircas phases, followed by an increase during the late Las Pircas and the later Tierra Blanca phases when sedentism and agriculture develop. Although there are more sites during these earlier phases, the sites are small and seasonally occupied unlike the less numerous but larger and more permanently used later sites.

For the Q. Cupisnique, Carrizal, Q. Examen, Q. Pitura, Q. Pampa del Güereque, and other areas, the analysis of site density patterns provides no information about changes of population, due to the small sample size of the data and the lack of information for some phases. It can be noted, however, that the upper reaches of these drainages are characterized by smaller, less dense, and presumably earlier forager sites while the lower

elevated areas near the valley floors are associated with slightly larger, denser, and later Preceramic sites but not to the extent recorded for the Nanchoc basin (Dillehay et al. 1989). There are other quebrada fans that are minimally occupied through all time periods, as shown on Figure 1.2. We believe that the movement of habitation sites to downslope areas during the later Preceramic phases was produced by a combination of increased population density and the limitations of single-household gardening in the upper reaches of small alluvial fans during the late Las Pircas phase, at least within the quebradas of the Nanchoc Valley and probably elsewhere. In the following section, it is suggested that an imbalance developed between populations and resources as the productivity of natural resources may have declined in some lower elevated, drier quebrada areas during the late Las Pircas and Tierra Blanca phases. If there was a substantial increase in population or an increasing population density in certain areas, this might have produced resource stress in some areas, particularly the lower elevated drier areas. This seems not to have been the case of the late Las Pircas and Tierra Blanca phases in the Nanchoc Valley, where food crop production was developed (Dillehay et al. 2007).

In the Nanchoc basin, the increase in site frequency and density beginning in the late Las Pircas and Tierra Blanca phases indicates that this area experienced both an increase of population and an aggregation of the population. In this area, the increasing exploitation of the quebrada-edge riverine habitat and the establishment of agriculture also may suggest that there was some stress placed on secondary wild resources and that people began to aggregate in the lower elevations of the Nanchoc area below 600 masl. Since there was no apparent decrease in the maximum resource productivity in this area, it seems probable that any stress may have been generated by a slight human population increase but offset by irrigation agriculture by at least 6000 BP or earlier. Although numerous indeterminate Preceramic sites exist in areas outside of the Nanchoc drainage, very few reveal late Las Pircas and Tierra Blanca house types, canals, and other features (with the exception of Q. Talambo), suggesting that the level of socioeconomic development taking place in the Nanchoc area between 9800 and 5000 BP was not occurring elsewhere in the wider study area. Presently, we do not know all reasons for these presences and absences during these phases, although some areas may have been avoided due to excessively thick vegetation and perhaps diseases (e.g., Leichmaniasis; cf. Dillehay 1991a; Gade 1979) on the valley floor. However, as discussed in the next chapter, we must explain why house gardening during the late Las Pircas phase and canal irrigation during the Tierra Blanca phase began

in only the dry forest of the Nanchoc pocket. (Irrigation water in the dry Nanchoc forest was drawn from streams descending from the higher elevated humid montane forest.) It may be that the site clusters we have called dispersed or "pseudo-dense" during the late Las Pircas and Tierra Blanca phases represent stress-related aggregation. But then, why are other quebradas nearly empty of contemporary populations and why are people clustered on only the south side of the Nanchoc area? Is it the case that a certain social collective threshold of individuals and household community sizes was required to cultivate crops in the face of broad-based resource stress affecting neighboring areas, especially those located downvalley, before the landscape began to "fill" between 7000 and 6000 BP? This same stress may explain why the littoral zone from Puerto Eten to Huaca Prieta also was beginning to be occupied during this period.

In summary, all areas suggest some evidence of possible population-resource imbalance during all phases but especially in the late Las Pircas and Tierra Blanca phases. It seems likely that the combined effects of environmental change, population increase, and population aggregation generated some resource stress in some lower elevated areas but that the relative importance of each factor varied among the areas. Population-resource imbalance caused by environmental changes and/or population increase could have created important shifts in strategies for responding to stress. The use of domesticated plants, house gardening, and irrigation agriculture could have been new risk-reduction strategies or low-risk intensifications in Nanchoc and part of the Q. Talambo (Rossen 1991). Further, the low frequency of sites in some nearby quebradas (e.g., Nueva Arica, Pampa de Leque Leque, Q. Examen) either suggests that few sources of water (i.e., active springs and streams) were available for human aggregation or that resource stress was not a problem that would have forced stressed people to move to less populated areas or both. We conclude that people chose to aggregate in the Nanchoc area regardless of local environmental and resource conditions, as best evidenced by the aggregated sites in the Tierra Blanca area where irrigation agriculture developed during a period of increased warmth and humidity in the region.

As for estimating population sizes, so few sites exist for the El Palto phase that probably small bands of fewer than twenty persons continuously and probably seasonally occupied areas such as Carrizal and Q. Talambo, Q. del Batán, Q. Pitura, Q. Pampa del Güereque, and Q. Cupisnique where the majority of the Paiján sites are found. Late Paiján sites associated with proto-household structures possibly were occupied for several months of the year and by as many as eight "families" at localities such as PV-19–27

at Cerro San Nicolas where eight structures were found. As documented by Chauchat et al. (2006) in the upper reaches of the Cupisnique drainage and by our work in the Q. Talambo and Q. del Batán, moderate to high densities of late Paiján campsites suggest a semi-permanent to permanent occupational presence and reduced territoriality characterized by seasonal or carrying capacity adjustments that probably required movement from one locality to another within the same or a neighboring basin. Based on the number and density of Paiján sites in all areas, we conservatively estimate that between 150 and 300 people may have lived in the study area at any one time from ~13800 to 10000 BP. During the Las Pircas phase, we view an increase to between 300 and 500 people. The Tierra Blanca phase was probably represented by 500 to 1,000 people, as suggested by more household sites and more than eighty known domestic structures in the study area. Of course, we cannot presume that all of these sites were occupied at the same time. Yet, on the other hand, we do not presume that all sites have been recorded because some may have been destroyed by past and modern activities.

POPULATION ABANDONMENT/AGGREGATION

What was it that led the people living in dispersed households during the late Las Pircas phase in the Nanchoc Valley to aggregate into larger, more closely located houses near irrigation canals and the valley floor during the subsequent Tierra Blanca phase? Why did change occur from house gardening and individual control of food production during the Las Pircas phase to multiple family/communal cultivation and public ritual at mounds in the Tierra Blanca phase? Clearly, there are potential benefits to such a move, especially in times of possible environmental and resource stress in some areas between 9800 and 5000 BP when the regional climate was characterized by increased warmth, but aggregation also entails costs. Among the advantages, we might count slightly increased interaction among task specialists (e.g., tool makers, horticulturalists) and to more level cultivable land, and consequent increases in the ease of mobilizing a labor force for working and maintaining canals and agricultural fields, social cohesion, and defense. Furthermore, access to potential mates would have been fostered by closer proximity, but this proximity is minimal given the relatively short distances (~200–400 m) between houses in the late Las Pircas phase too. Increased ritual activity across the valley at the mound site of CA-09–04 during the Tierra Blanca phase also may have brought multiple groupings closer together at key times of exchange and matchmaking.

The production of lime for coca consumption possibly played a role in the aggregation process. Labor management is also likely to have been a major factor too, especially between 7800 and 5000 BP when the canals and agricultural fields were in use. Although individual families may have seen to their own food needs, the only time of year when the cooperative action of a labor force was needed would have been for maintenance of the canal, agricultural fields, and the mounds at CA-09–04. Safety also increases with aggregation; a larger settlement means a larger pool of able-bodied people to defend the community and its stores of food. We do not know if households were vulnerable to attack from outsiders, though the disarticulated human skeletal evidence from the Tierra Blanca sites suggests social conflict and bodily mutilation (see Chapter 8) either between households or between neighboring groups vying for local resources or for other reasons. We view labor for working the fields and canals and perhaps communal safety as the two most likely reasons for settlement aggregation closer to the valley floor. More aggregation occurred when self-sufficient gardening households of the Las Pircas phase changed to multi-household irrigation cultivation during the Tierra Blanca phase. That is, a move from small, scattered circular households during the Las Pircas phase to larger, more closely spaced communities characterized by rectangular households during the Tierra Blanca phase would have increased slightly the cost of transporting harvested noncrop supplemental foods, as the larger community population required a larger food-gathering territory. The advantages of social cohesion may have been negated at least in part by the increased potential for interpersonal conflict that may have developed in closer cohabiting groups.

There appears to have been a peak of cultural occupation about 8000–5500 BP, perhaps indicating some kind of climax in the number and size of household communities along streams of alluvial fans at this time, particularly in the Nanchoc basin. Other cultural practices in the interior of the quebradas in the Zaña Valley after 5000 BP illustrate a reduction in the size of houses and the abandonment of some areas, especially the Nanchoc basin and the upper reaches of some quebradas. But people continued to live in the Q. del Batán, Q. Talambo, and other quebradas in the lower foothills. Based on evidence from all areas, it is clear that the period of 5500–5000 BP was one of significant change in the interior and along the coast, and thus researchers need to focus attention on the question of why similar shifts occurred from aggregated household communities to small household occupations in many localities of the study area. Not known is why many of the Tierra Blanca phase sites in the Nanchoc basin were

reduced in number or abandoned during this period and if this was related to social, economic, or environmental variables. We think it may be related to population increase and to local settlement shifts closer to larger fertile areas farther downvalley near places like Macuaco, Oyotun, and Cerro Corbacho in the middle Zaña Valley (Dillehay et al. 1989) and Cerro Guitarra and the coastline in the lower valley. There is little evidence of a similar shift in the Jequetepeque Valley. Last, although certain areas were not occupied, the resources in them probably were continually used.

DISCUSSION

Earlier researchers emphasized seasonality and seasonal or transhumance movements across the vertically stacked ecological zones of the Andean landscape when modeling early to middle Preceramic settlement patterns and how food resources were combined (e.g., Lanning 1967; Lynch 1973). Subsequent research has restricted the model to the late Pleistocene and early Holocene periods (cf. Aldenderfer 1998; Santoro 1989). During the El Palto and early Las Pircas phases the subsistence evidence suggests that people exploited a wide range of resources in a wide variety of resource zones from the coastal plains and littoral zone to the middle slopes of the Andes and camped near predictable water sources. After ~9800 BP, people increasingly stressed food and water resources that were more diversified, predictable, productive, and low in risk (e.g., tubers, mammals, fish and shellfish, crop foods such as manioc, peanuts, and squash). This shift in the balance of subsistence strategies is explicable if they were choosing, or being compelled, to adopt less mobile lifestyles within more circumscribed zones as overall population sizes increased through time. These trends are best documented in the Nanchoc area.

Surveying the record left by the late Las Pircas and Tierra Blanca phase peoples across the study area, we have some evidence for the emergence of economic strategies characterized by elements of delayed, rather than immediate, forms of labor investment (Woodburn 1980). Intensive, perhaps often managed, exploitation of r-selected resources (i.e., quinoa, peanut, bean, *pacay*, *algarrobo*, fish, shellfish, etc.) that demanded specialized procurement, processing, and storage technologies characterizes these phases. In the Nanchoc pocket, some of these plants (certainly quinoa and manioc, probably peanuts) could not have been "procured" nearby. They had to have been relocated and established locally and combined with locally available plants. These resources are also associated with range reduction, increased sedentism, the creation of permanent burial places

(either inside or outside of houses), enhanced intergroup competition and exchange, and greater localization of material culture as a means of structuring the social interactions and defining or contesting individual group identities. Population increase is observed between the El Palto and Tierra Blanca phases but not increased settlement of previously marginal environments such as the numerous almost site-free quebradas of Q. Examen, Q. Pitura, and others, including a few small quebradas in the Nanchoc area.

In disentangling the cause and effect within these trajectories, social, political, and ideological factors as well as ecological and demographic ones all played determining roles. Exchange between groups practicing different subsistence and settlement strategies is another factor to consider, especially during the late Las Pircas phase when we witness the presence of exotic curiosities. To assume too tight a set of linkages among dietary broadening, the specifics of the resource ecology of the dry and humid forests on the northwestern slopes of the Andes, and sedentism and social change would be incorrect, however. Although increased emphasis on plant foods from the late Paiján phase to the Tierra Blanca phase is identifiable in the archaeological record, it does not follow that the social consequences this entailed were always identical, because greater social complexity took place primarily in one area – the Nanchoc Valley. Furthermore, if anything, there seems to be a narrowing of the resource base from late El Palto and Las Pircas times to the Tierra Blanca phase. This pattern seems to be the result of less dependence on wild plants and animals and a greater incorporation of cultigens during the late Las Pircas and Tierra Blanca phases. The way resources were combined together within a total subsistence and settlement pattern, social organization, and ideology all played a part.

What happened after 5,000 years ago in the Nanchoc basin of the upper middle Zaña Valley? Apparently little; the area was lightly occupied after this period. For reasons not yet fully understood, the settlement pattern shifted to the broader floodplains in the lower Zaña Valley at sites such as Cerro Guitarra where a larger agricultural population could be supported, to the brackish water wetlands along the coast, near the Initial Period site of Purulén, and now also to highland elevated areas located between 2,000 and 2,800 m in elevation at other Initial Period sites like Uscundal, La Toma, and Monteseco (Dillehay and Netherly 1983) in the upper Nanchoc basin. In the Jequetepeque Valley, the Q. del Batán, Q. Talambo, and others continued to be occupied but less than in the earlier periods. People moved to larger agricultural spaces and to places where different economies could be combined. The shift also was to places where different economies

could be combined. That is, the littoral provided maritime resources and agriculture, the nearby highlands agriculture and camelids.

Last, although many local cultural transformations during the periods under study here are understood in terms of climate and environment changes, others are not. An intriguing paradox in the Nanchoc Valley is that just when increased arid climatic conditions and possibly resource stress occurred in several habitats in the area, especially those located in lower elevations near the arid coastal plains, between 9800 and 5000 BP, people in the Nanchoc area developed certain initial pulses toward social and economic complexity, such as the transition from mobile foraging to sedentary strategies, mound building, and the adoption of cultigens and irrigation agriculture. How do we explain this paradox, and are climate, social, ideological, or other factors most accountable?

CHAPTER THIRTEEN

Foraging to Farming and Community Development

Tom D. Dillehay, Jack Rossen, and Kary Stackelbeck

The shift from foraging to farming and from commonplace practices by multiple groups to greater sociocultural creativity by only a few groups is a complex process that has been approached by scholars in different ways. For instance, in Africa, the first shift has been viewed as a continuum of people-plant interaction based on the resource richness of ecotones (Harris 1989). In contrast, scholars working in regions like Panama, India, Pakistan, and the Near East have modeled the onset of plant cultivation as a result of seasonal food shortages and climate change crisis (Mehra 1999). In Papua New Guinea, scholars believe it was the technological advances of low-risk horticulture that accelerated deforestation and led to agriculture (Golson 1989). In various sectors of the Andes, plant cultivation has been variously viewed as a strategy for reclaiming land following environmental catastrophes like volcanic eruptions and as a result of long-term cultural and ideological processes involving the roles of food in identity and politics (Hastorf 1999). In regions like the eastern United States, the prevailing model is that there was little to no intentionality involved in the development of cultigens and instead there was a process of co-evolution and plant-human interdependence (Rindos 1984; Smith 2001). There is thus a wide variety of models, and a definite sense that each region had distinctive cultural and environmental circumstances, along with concomitant creative social, technological, and ideological changes, that nurtured plant cultivation and ultimately farming. It is in this spirit of the diversity of circumstances and conditions that can contribute to social and cultural change and economic intensification that we present the discussion of our study area. As noted below, the circumstances and changes in our area that led to farming are different in many ways from those discussed in other models, with less emphasis on environmental causes and more on social decisions.

Sites and data patterns in all subareas of this study are interesting in their own right, but they are especially important because of their bearing on the initial adoption of agriculture and on the emergence of social complexity in one area of northwestern Peru. The study poses two questions: Was farming integrated into the economy rapidly in some places and more slowly in others? What was the social impact of this event? The answers depend upon how we model the initial spread and adoption of agriculture and its consequences. Several fundamentally different processes have been proposed to describe the diffusion of agriculture into South America. A long-standing model holds that between 10000 and 7000 BP there was a more or less continuous distribution of pre-agricultural foraging and/or pastoral groups (Bird 1943, 1948; Browman 1974; Sauer 1952; cf. Aldenderfer 2006; Bonavia 1993). It also is thought that the seeds and knowledge of agriculture were transmitted from one foraging, if not farming, group to another, eventually reaching Peru from areas farther north in Colombia and Ecuador and farther east in Amazonia (Pearsall 2008; Piperno 2006b; Piperno and Pearsall 1998). Currently a number of different models suggest reasons that increased reliance on crops occurred, implicating various push and pull factors on the coast and in the highlands (Hastorf 1993; Piperno and Pearsall 1998; Piperno in press a,b). Another approach envisions agriculture, at least in part, spreading by actual migration of agriculturalists (Lathrap 1970; Roosevelt 1980).

The answer probably lies in a combination of these and other approaches and must be studied for each region. These differing points of view parallel discussions surrounding the diffusion and spread of agriculture in other parts of the world. However, the different approaches have different implications for our understanding of early agriculture in the study area. Unfortunately, it is difficult to distinguish between these alternatives on the basis of archaeological evidence alone. Whether cultivation spread by diffusion or migration into the study area, its role in a foraging subsistence regime is a question of congruence of a foraging ecology and the organization of mobility and sedentism, the spatial ecology of natural biotic systems, and the restrictive demands of agriculture. There is a strong implication supporting diffusion of such plants as squash, manioc, peanuts, quinoa, and later maize because of the peculiarities and variable origin hearths within this suite of early cultigens (Dillehay et al. 2007, 2008; Pearsall 1992; Piperno 2007; Piperno and Pearsall 1998). It also is possible that some cultigens came with migrants, but other than plants there are few other cultural indicators supporting this option. On the other hand,

given the tropical to semitropical setting of the study area, it is likely that cotton, coca, and some fruits were diffused from nearby coastal or lower elevated mountain areas or developed locally.

Though the role of plant food intensification figures prominently in several models of Andean prehistory (e.g., Bronson 1977; Martins 1976; Pearsall 2008), only Rossen (1991; cf. Piperno 2006b) has addressed briefly the processes by which this might have occurred in the forested valleys of the study area. He postulates the adoption of cultigens as part of a strategy of low-risk intensification in the moderately to highly productive seasonally dry forest environment of the Nanchoc Valley. In this section, we examine this approach and the possible pathways to plant food intensification for Preceramic people in the study area. As we use the term here, intensification refers to the process of increasing plant food production (i.e., increased output) via various mechanisms that may or may not have involved increased energy costs. We are also aware of Bender's (1978, 1981) definition of intensification based on social reorganization and intent to produce more. In terms of changes in domestication, architecture, site organization, and ideology, this definition of intensification is also relevant to our analyses. As reviewed later in the chapter, people in the study area may have pursued several different strategies to accomplish this goal, beginning as early as 10200 BP in the Nanchoc area (Dillehay et al. 2003). Some evidence suggests that foragers living in the Q. del Batán, Q. Talambo, and Q. Cupisnique, and others residing along the Pacific shoreline did not achieve this goal until much later, perhaps 7,000 to 4,500 years ago, although prior work in the Cupisnique area by others did not specifically test for cultivars in archaeological sites (e.g., Chauchat 1988).

Last, despite our efforts to compile the archaeological evidence of plant use, our ability to evaluate the overall utility and intensification potential of plant foods is restricted by the limitations of the archaeobotanical record. In the case of overall cultural utility, the limited archaeobotanical data can be used to suggest only that peanuts, manioc, quinoa, squash, and later maize were probably adopted from transient foragers/farmers passing through the area and/or more likely diffused into the area via down-the-line exchange with distant farmers (Dillehay et al. 2007). Plants such as squash, peanuts, manioc, and quinoa carry a strong implication of diffusion or down-the-line exchange because their origin hearths are so distant from Nanchoc in opposite directions. For other plants and plant food groups, such as cotton, coca, beans, *pacay*, and fruits, however, the data are too sparse for us to evaluate domestication or adoption processes, although these appear to be

local or regional (see Chapters 9 and 14). Most likely, this process occurred in stages, as later maize varieties and farming techniques were adapted to new climatic and edaphic conditions.

PATHWAYS TO FARMING

We envision four possible pathways that Nanchoc peoples could have taken to intensify plant resources: cognitive, social, technological, and ecological. These strategies are not mutually exclusive (for example, technological and ecological solutions may allow for increased harvests) nor are they necessarily hierarchical in the order in which they might be adopted. Cognitive approaches refer to decisions concerning the kinds and quantities of plant foods selected and utilized. As one strategy, people can choose to intensify and expand diet breadth by collecting a wider variety of plants or by hunting smaller animals. Alternatively, or additionally, people can increase the harvest of resources already being used. Social pathways, such as the expansion of kinship networks and exchange relations, provide another means of increasing access to foods and other resources. Technological innovations represent a third set of strategies to enhance plant food production. Included in this category is a variety of plant harvesting/processing, a unifacial lithic industry, ground stone, storage technologies, and irrigation ditches and canals (Dillehay et al. 2005; Rossen 1991, 1998). Finally, an ecological approach includes various strategies used to maintain and enhance key plant resources, ranging from the maintenance of habitats using fire to practices affecting only specific resources. Ideological change in the form of intensification ritual is a companion process that is also involved in the development of early plant cultivation systems (cf. Bellwood 2004; Bender 1978; Hodder 1990; Wilson 1988).

Survey in the Nanchoc basin has identified late Pleistocene to late Holocene residential sites in several landscape settings. During and after the terminal Preceramic period, floodplains located 10 to 15 km farther downvalley in the more expansive middle Zaña Valley (e.g., Oyotun and Cayalti areas; see Fig. 1.1) were more intensively occupied probably to produce more agricultural crops for a growing population. However, these middle valley groups continued to exploit upper and lateral quebrada and foothill resources in Nanchoc and surrounding areas through either regular expeditions or seasonal occupations. In this regard, we think that there was a site pattern that may represent three coterminous and interdependent settlement systems based on foraging and on irrigation agriculture. One system consisted of long-term settlements of sedentary farmers practicing

canal-directed floodwater farming on floodplains and along the borders of adjacent alluvial fans of the Nanchoc area. Another consisted of more frequently shifting Tierra Blanca and later terminal Preceramic and Initial Period settlements of groups focused on limited farming at lower elevations in the Zaña and Jequetepeque valleys, with some floodwater and canal farming at the mouths of enlarged mountain canyons (i.e., Oyotun, Q. Talambo; Stackelbeck 2008), a pattern initiated during the late Las Pircas phase in the Nanchoc area. There also is the possibility of opportunistic farming in low areas of the coastal plains after El Niño events. Evidence indicates that a third system was foragers subsisting on a variety of nondomesticated faunal and floral resources that continued living in the Q. del Batán, Q. Cupisnique, and other subareas in the lower foothills of the Andes, as well as on the coastal plains and along the littoral. Several scales of socioeconomic organization were present at the same time, possibly with nested heterarchies filled by different types of foragers and farmers.

Perhaps the most difficult factor to grasp in the development of Las Pircas phase households in the Nanchoc basin is the ritual processes that occurred. Careful cutting and placement of male human bone, perhaps a form of ritual cannibalism (Dillehay et al. 2000a,b; Rossen 1991; see Chapters 5 and 8), and the deposition of quartz crystals in furrowed areas possibly indicate that garden magic was part of a local ideology and occurred in coordination with early house gardening. This suggests that ideological factors also played a role in the development of plant cultivation, or that they were a consequence of intense human-plant relations resulting from their adoptions.

In further considering the adoption of agriculture, a potentially important other factor is climate change. By 8500 BP, optimal conditions existed for more of the region's middle Holocene foragers to take up agriculture. Netherly's analysis of the regional and local paleoenvironment (see Chapter 3) suggests that slight increases in summer temperatures at this time created different vegetation patterns in the forested areas of the Nanchoc basin, with the results that streams probably went from occupying incised channels to meandering across fertile, aggrading alluvial fans. As such, this climatic intensive agriculture correlates with a documented shift from a dry climatic regime during the early Holocene period to a cool-wet one after ~6000 BP. Yet the change was a contributing factor but not necessarily a primary causal one in the adoption and spread of agriculture. Similarly, the changes in settlement and subsistence that occurred between 6500–6000 BP in the Nanchoc area appear to have been in a relative

stable environment within the scenario of climate change across the study area.

Last, in the Nanchoc basin and other parts of the study area the high productivity of the seasonally dry forest, the close accessibility of other biotic communities, the cultivation of both food and industrial crops, and the storability of wild plant resources supported the development of sedentary communities prior to the arrival of maize and other food crops (e.g., potatoes, avocado, and other fruits, tomatoes; Dillehay et al. 1999; Rossen 1991). In support of this pattern are the house structures, storage pits, waisted hoes and grinding stones, canals, and thick floors and trash middens documented at several Las Pircas and Tierra Blanca phase domestic sites in Nanchoc Valley and Q. Talambo.

EARLY WATER CONTROL

We found evidence of water control for agriculture and probably domestic use by early farmers in the study area (Dillehay et al. 2007; Stackelbeck 2008). Garden furrows found at the Las Pircas sites of CA-09–27 and CA-09–52, dated between 9000 and 8000 BP, suggest that water was distributed to garden plots from small unidentified ditches stemming from streams in the higher areas of the quebrada fans and the humid montane forest located above 1,500 m in the valley. At several sites in the Nanchoc Valley, excavated in 1989, 1992, and 2003, a sequence of canals constructed between possibly as early as 6800 but certainly by 5600 BP conveyed water ~2 km in the Nanchoc River to irrigate fields near the edge of the floodplain and below a series of alluvial fans on the south side of the river, indicating that they diverted runoff from higher terraces to lower benches. This canal system has a possible affiliate and perhaps a longer history of development of ditch or canal technology at sites JE-393 and JE-901 in the Q. Talambo and Q. del Batán areas, respectively. At these sites the presence of domestic ditches (Dillehay et al. 2007; Stackelbeck 2008) suggests possible exploitation of both surface bowls and high water tables in alluvial fans of the lower valley. Not known in these two cases is whether seasonal runoff water or perennial water was used.

The garden furrows, canal systems, and agricultural fields of the late Las Pircas and Tierra Blanca phases, respectively, represent reduced mobility and increased sedentism, and the development of communal organization and labor. It can be argued that the mounds at CA-09–04, house groups, and canals and fields in the Nanchoc areas represent the development of

a multi-household social integration above the level of the individual or aggregated households of the Las Pircas phase.

Currently, there are no known precedents in the Andes for early canal systems in the Nanchoc and Talambo areas. Only through systematic subsurface explorations of floodplains and lower quebrada fans of both coastal and highland valleys will we learn whether irrigation technology was part of a wider agricultural complex that arrived from the outside or from an indigenous innovation in the study area. If the latter, then the early canal culture must be viewed as an important source of cultural and social change rather than just a secondary community that adopted agriculture and was on the fringe of Andean civilization. Regardless of the technological source, one issue is clear: the spatial aggregation of and population increase in multi-household communities during the Tierra Blanca phase occurred with the appearance of irrigation canals.

THE NANCHOC TRADITION: COMMUNITY LAND USE, EXCHANGE, AND INTERACTION SYSTEMS

To reiterate briefly, in focusing on people's interaction with the natural system of the study area, most environmental zones were patchy, and early mobile foragers of the El Palto and early Las Pircas phases exploited the diversity of resources inherent to the patches. With the exception of inland seasonal *algarrobo* forests and cactus stands and year-round marine lower-valley estuarine and wetland resources along the coast, foraging probably resulted in low return rates of caloric energy because of such factors as small animal size and widely dispersed plants yielding low calories. In some resource zones, particularly the forested Nanchoc area, foragers of the late Paiján and early Las Pircas phases were able to experiment with cultivation to increase ranked resources. The adoption of agriculture in this area was early and somewhat gradual, given that at least 2,000 years of mixed foraging and low-level cultivation preceded the adoption of strategies focused primarily on irrigating agriculture during the Tierra Blanca phase in the Nanchoc area. The eventual primary reliance on agriculture appears to be directly linked to advances in landscape management – specifically the downward migration of Las Pircas gardeners out of the side quebradas and canyons toward the main valley floor, and especially water management by Tierra Blanca farmers – and not to storage technologies (e.g., underground pits, containers), although they also exist. Water management with irrigation techniques created artificial moisture pockets in the Nanchoc Valley

(and perhaps elsewhere) that were used to grow or enhance the growth of plant food resources (Dillehay et al. 2003). With this development, a variety of crops was eventually added to an established foraging resource package. Thus, the process of crop adoption is seemingly not as important as landscape, water, and plant management. Furthermore, it is important to reiterate that agriculture did not spread evenly nor rapidly throughout the study area. Testing and excavations at thirty-seven sites in the Zaña Valley, Nanchoc Valley, the Q. del Batán and Q. Talambo, and elsewhere show that broad-spectrum foragers relying primarily on *algarrobo* pods, large and small animals, cactus fruits and leaves, other wild resources, and probably some cultigens continued into the fourth millennium BP. The absence of macro-botanical and micro-botanical (i.e., phytoliths and starch grains) remains at sites in the Q. del Batán and Q. Talambo, as well as the absence or minimal presence of other indicators of agricultural activity (e.g., canals, grinding stones, storage facilities, stone hoes, buried fallows) at these locales, indicate an economy different from that of the Nanchoc basin.

Although foraging and farming are by no means mutually exclusive strategies of subsistence, the relative significance of foraging across the study area cannot be understood without reference to both strategies. Groups and individual settlements could and did shift between subsistence foraging and farming; the conditions allowing farmers to exist in some environments is somewhat different due to soil conditions, water supply, and probably local social factors. We also suspect that some foragers were traders who exchanged local forest products for other items. We should keep in mind that a wide variety of forest products in the upper middle Zaña and Nanchoc areas (e.g., fruits, coca, *algarrobo* pods) must have been desired by outside groups living along the coast, on the desert, and in the nearby highlands. We would suggest that this kind of exchange network, along with an organizational ability to mobilize and exchange these resources, was central to the development and maintenance of relationships between foragers and others and probably to accessing the exotic cultivars brought into the area throughout the study period. Although more remains to be learned about the relationships between foragers and farmers in the area, it is probable that the farming populations in the valley were small enough so as not to threaten the environments of foraging peoples, and whatever the circumstance of their relationships, it is clear that the area supported a wide range of economic strategies from foraging to farming. Why continue practicing a foraging and long-distance exchange lifeway when agriculture and its incentives were available nearby? The incentive to continue foraging probably relates to the year-round to

seasonal abundance and availability of *algarrobo* pods, cacti fruits and leaves, snails, and other resources in many lower elevated areas, much in the same way that the coastline provided a year round abundance and diversity of foods.

The Las Pircas and Tierra Blanca communities were probably self-organizing through the interactions of the diverse inputs of all the participating households. These types of communities were comprised of a dynamic network of several households acting in parallel, constantly reacting to what the others were doing, especially during the Tierra Blanca phase. The communities were dispersed within aggregated areas on the alluvial fans and decentralized except during communal rituals at the Cementerio de Nanchoc site and later during the construction and maintenance of irrigation canals. If there was coherent behavior in the community, it must have come from negotiation and cooperation among the households themselves. The overall behavior of these communities thus was the result of a number of decisions made by many individual households. There must also have been a certain level of co-dependence between a variety of neighboring economic and social households during the Tierra Blanca phase, if not the earlier Las Pircas phase.

During the Las Pircas phase, it is clear that objects and materials circulated and some items from outside were imported and redistributed throughout the study area. As noted earlier, intra-regional exchange of cultigens and other commodities may have occurred in part as simple "down-the-line" exchange, particularly along rivers and inter-valley stream drainages or along the coastline, and thus did not necessarily require long distance movements of people. Yet, certain lines of evidence suggest that such exchanges may have been embedded in increasing regional interactions, likely including the movement of some people, as part of a process of increasing social and perhaps occasional ritual integration at places like the mounds at CA-09–04 and intensification and spatial expansion of economic interactions after 7800 BP when other long-distance cultigens (but not other exotics) moved into the area. An intensification of these processes at this time is the larger houses that first appear in the Tierra Blanca phase in the Nanchoc Valley and later in certain localities of the Q. Talambo. These areas contained multiple households linked economically and socially in various respects as household clusters, possibly residential kin groups (Dillehay et al. 2004). The appearance of larger rectangular and often internally segmented houses during this phase is a marker of a substantial reorganization and intensification of the domestic mode of

production, including increases in food production, storage capacity, and sedentism.

Further, the centrality of the Nanchoc populations between the coast and highlands may not have resulted solely from their positioning with respect to the close multiple stacking of different ecological zones along this section of the western Andean slopes. They may also have flourished because they were in a position to limit or otherwise regulate access of other adjacent and more distant groups to the dry forested slopes of the Nanchoc area and perhaps to the production of certain local products, such as cotton, coca, and fruits during the Tierra Blanca phase. We think this might be a critical point in the development of the mounds and canals along the Nanchoc River between 7800 and 6000 BP. With the location of Tierra Blanca sites at the lower end of the quebrada fans to more directly access fertile agricultural soils, the settlement pattern changed from the previous semi-aggregated type of the Las Pircas phase into an aggregated pattern. Considering these patterns together, resource harvesting became more intensive and the scope of resource acquisition around the Tierra Blanca canal grew considerably.

Between 5500 and 5000 BP, settlement in the Nanchoc basin and the upper middle Zaña Valley was reduced significantly and the Tierra Blanca phase sites appeared to have been abandoned. Several propositions can be made regarding the cause of any changes in land use and settlement patterns after 5000 BP. First, as discussed previously, due to some kind of environmental deterioration, it may have become more difficult to maintain the higher level of aggregation of population supported by the Tierra Blanca settlement pattern, especially in more arid environments like the Q. del Batán and Q. Talambo near the coastal plains but less so in the Nanchoc basin. Adding to this, there are at least two points suggesting that climate change could not have made an impact strong enough to cause wholesale change in settlement patterns at this time. First, settlements located at ecotones like the Nanchoc basin constituted a key node of the economy, which was the basis for the development of a combined forest-shrub ecosystem stretching from the Nanchoc basin to ecological zones farther west. The general scale and size of sites increased from the Las Pircas to the Tierra Blanca phases. As seen in Figs.12.1 to 12.3, land use in this area changed from the former dispersed pattern of the El Palto phase into a semi-clumped to an aggregated pattern from the Las Pircas to the Tierra Blanca phases, respectively. Further, the increasingly aggregated pattern took place from ~9800 to 6000 BP during the peak of the so-called hypsithermal arid period, as evidenced by the appearance of

cultigens, canals, and mounds in the study area. These observations underscore the point that environmental change did not have a negative effect (at least on the Nanchoc area) and also suggest that shifts in settlement patterns did not necessarily happen instantly in response to environmental shifts.

Another hypothesis concerning the settlement pattern change relates to intersocietal conflict. Tension with other groups may have occurred for various reasons such as a breakdown of sharing agreements for resource patches or exchange agreements. The archaeological evidence also suggests a conflict hypothesis; the limited presence to absence of exotics and any cultural influence from other areas during the Tierra Blanca phase, with the exception of cultigens from long-distance areas, can be observed in the types of artifacts, especially those from the Nanchoc area. Such changes in material culture happened gradually, perhaps with a cultural hiatus. Thus, cultural change was a subtle phenomenon that we might expect in the case of a shift in population downward in the quebradas toward the main valley floor, perhaps as a result of conflicts with other local groups. The mutilated human remains for both the Las Pircas and Tierra Blanca phases suggest a similar we/they, or local and nonlocal, dichotomy and social conflict. However, the haphazard breakage associated with human remains of the Tierra Blanca phase suggests more aggression and enmity to people than does the careful cutting and placement of bones during the earlier Las Pircas phase. Although difficult to examine at this time, these patterns could reflect a shift from cutting one's own relatives (endocannibalism) during the late Las Pircas phase to the mutilation of bones from the other (exocannibalism) during the Tierra Blanca phase.

THE ECONOMIC FOUNDATIONS OF ANDEAN CIVILIZATIONS

Understanding the nature of Preceramic subsistence practices is one of the cornerstones for postulating the development of the economic foundations of Andean civilization (e.g., Bonavia 1991; Dillehay et al. 2004; Lavallée 2000; Moseley 1975). It was once thought that permanent settlements, early monumentalism, corporate labor, and nonegalitarianism first relied on an economy based primarily upon maritime resources (Moseley 1975; cf. Patterson 1983), although early agricultural settlements also were known in the interior coastal valleys. In the highlands, early complexity focused on the interplay between agriculture and pastoralism (e.g., Aldenderfer 1998, 2006). In recent years, a more neutral approach has been taken that views

the early foundations as having been underwritten by mixed economies that changed regionally as greater social complexity and increased populations occurred (e.g., Dillehay et al. 2004; Lanning 1963, 1967; Moseley 1992, 2005; Patterson 1971).

To elaborate briefly, maritime economies have been suggested for populations of the late Pleistocene that occupied the coastal zone prior to the rise and stabilization of the sea level (e.g., Chauchat 1988, 1998; Dillehay 2000a; Sandweiss 2003, 2005a,b). Most early sites were submerged by rising sea levels at the end of the Pleistocene, which precludes an accurate assessment of early settlement/subsistence patterns. Nonetheless, evidence for late Pleistocene and early Holocene maritime economies has been found along the central and southern coasts of Peru at the sites of Q. de los Burros (Lavallée et al. 1999), Q. Jaguay (Sandweiss et al. 1998b), and Q. Tacahuay (deFrance et al. 2001). Deposits at these sites variably include remains of marine mammals, fish, mollusks, and birds – in some cases to the exclusion of evidence of terrestrial resources.

In considering the arguments of Chauchat et al. (1998, 2006) for a maritime focus of the Paiján economy, Gálvez and Quiroz (2008) contend that varied faunal remains from early sites of the Chicama/Cupisnique area – particularly in the upper reaches of quebrada drainages – reflect a much broader economy focused on different ecological zones. Gálvez and Quiroz (2008) further suggest that Paiján points were more likely used in the process of hunting land mammals such as deer, and that net technology would have been sufficient to acquire the smaller and larger fish that were exploited by Paiján populations (Gálvez and Quiroz 2008). Our collective data from the Zaña and Jequetepeque Valleys support the interpretation of Gálvez and Quiroz (cf. Dillehay 2000a; Dillehay et al. 2003). They also support Moseley's contention that the Paiján culture was the first on the north coast of Peru to establish certain techno-economic pulses toward social complexity (Moseley 1992), as evidenced by the aggregated proto-households mentioned earlier.

Several middle Holocene sites along the coast and littoral zones, whose periods of occupation range between ~8200 and 5500 BP, indicate subsistence economies that were similarly focused on marine resources. The more prominent sites include La Paloma and Chilca on the central coast of Peru (Benfer 1984, 1986, 1990; Donnan 1964; Engel 1966; Quilter 1989; Reitz 1988), El Anillo and Yara on the south coast of Peru (Sandweiss et al. 1989), and various sites of the Camarones Complex and Chinchorro in northern Chile (Bird 1943, 1946; Llagostera 1992; Schiappacasse and Niemeyer 1984; Standen 2003).

Earlier occupation at the Las Vegas site (~11500–8500 BP) in southwestern Ecuador also indicates a more mixed economy that included deer, peccary, fox, edible fruits from plants and trees (e.g., *Opuntia* cactus and *algarrobo* trees), and fish and shellfish from nearby mangroves (Stothert 1988). In addition, early Las Vegas populations transitioned from exploiting wild varieties of squash (*Cucurbita*) to intentionally growing domesticated squash by 11500 to 10800 BP (Piperno and Stothert 2003). Intensive exploitation of plants, including domesticates, is also evident among Preceramic occupations of the Huarmey Valley, such as at Los Gavilanes (Bonavia 1982b). A mixed economy of terrestrial and aquatic resources is also indicated among Preceramic sites of Villa del Mar and Carrizal on the south coast of Peru (Wise 1999) and in the Chicama/Cupisnique area (Chauchat 1988; Chauchat et al. 1998; Gálvez and Quiroz 2008). Although little is known about the later periods after ~5500 BP, several Preceramic coastal (e.g., Bandurria, El Paraíso) and inland sites (e.g., Caral and other sites in the Norte Chico area; Haas and Creamer 2006; Shady 2000, 2005) exhibit large-scale monumental architecture with economies based primarily on agriculture and secondarily on marine products. As discussed in Chapter 2, these sites clearly reflect the beginnings of permanent towns, possibly ceremonial and exchange centers, social inequality, and public ideology.

The faunal and botanical remains from our study area point to the simultaneous but spatially and temporally uneven convergence of maritime, agriculture, and foraging economies, depending upon the location of sites on the coastal plains and in the foothills. There are a number of both wild faunal and floral species that are present throughout the El Palto, Las Pircas, and Tierra Blanca phases, although they decrease significantly in number and diversity through time, particularly in the Nanchoc basin where agriculture began (see Chapters 9 and 10). The late Paiján subphase to early Las Pircas phase witnessed the advent of cultivation (i.e., squash), a process that intensified over time and resulted in the manipulation of the landscape to develop a growing agricultural infrastructure, at first house gardens and probably feeder ditches to household garden plots during the Las Pircas phase and then canals and larger crop fields during the Tierra Blanca phase (Dillehay et al. 2007, 2008; Rossen 1991). We have no evidence to suggest early economic development along the coast, but as noted earlier, complex social and economic transformations were occurring in other coastal areas by at least 8,000 years ago.

Thus, what can we say about the early Andean economy and the rise of civilization in our study area? Certainly there was intentional cultivation of

key resources during the late Paiján to Tierra Blanca phases, many of which were domesticated. It is equally important to realize that wild resources always supplemented domestic ones throughout the study areas during all phases but much less so in the late Las Pircas and Tierra Blanca phases. With the exception of domesticated squash in the late Paiján subphase, people during the El Palto phase were generalized foragers exploiting a wide range of wild plant and animal resources. A mixed forager lifeway continued into the Las Pircas and Tierra Blanca phases in the Q. Cupisnique, Q. del Batán, and Q Talambo. Given the presence of fish bones at nearly all sites during all phases in the study, including several in the Nanchoc basin, we can surmise that people were living along the coast in early times and exchanging marine foods into the interior or inland people were directly exploiting the littoral zone. We thus perceive a multiple-origin economic model for the beginnings of Andean civilization in our area of study. While the Nanchoc basin can be viewed as having an early farming society that intensified through time, as evidenced by the economic, artifactual, architectural, and organizational data, extensive and intensive farming did not occur in other sectors of the study area, at least not until the terminal Preceramic period at ~5,000 to 4,500 years ago. In other areas, such as the Q. del Batán, Q. Talambo, and Q. Cupisnique, a mixed forager and perhaps farming lifeway was pursued. Along the coast, fisherfolk based their economy on marine resources, with resource exchange taking place among all groups from the Nanchoc area and the highlands above down to the coast.

SUMMARY

There was a generalized forager adaptation to the coastal plains and adjacent western slopes of the northern Peruvian Andes between 13,000 and 11,000 years ago that resulted in a pattern of scheduled, possibly seasonal movements between coastal and interior locations, where various plants, animals, and seafood would be available during all or at different times of the year. As noted previously by Dillehay, Rossen, Stackelbeck, and Maggard, regional and local variation in late Paiján stone tools and raw material indicates constriction of local territories, which we regard as territorial, if not semisedentary. This constriction of territory, reduced mobility, and agglomeration of population continued and accelerated past 9,800 years ago into the Nanchoc Cultural Tradition, which is divided into two phases: the Las Pircas and the Tierra Blanca phases. In some areas, this pattern of resource exploitation began to change rapidly between 9,800

and 7,400 years ago. For instance, in the upper middle Zaña Valley between 800 and 2,000 m above sea level, forest foragers began a local permanent or semisedentary life during the Las Pircas phase with small organized communities, careful burial of the dead (though other human bones were disarticulated and placed in pits), domestic circular houses, initial mound building at CA-09–04, house gardens, and subtle social differences. The technology was dominated by unifacial tools, a varied ground stone technology, simple food storage, and a food economy based on cultigens and some wild plants and animals. The Las Pircas sites yielded cultivated squash, chenopodium (cf. quinoa-like), peanut, yucca, and several unidentified wild fruits. Low frequencies of exotic materials (e.g., marine shell, carved stingray spines, quartz crystals, and raw stone material) suggest minor contact with distant coastal and highland areas.

The following Tierra Blanca phase between 7,800 and 5,000 years ago was marked by changes in house style (from small elliptical to larger, multiple-room rectangular) and the addition of cotton, beans, and coca. Although exotics disappeared, the separation of public and private space was more pronounced as evidenced by the dual, stone-lined, multitiered earthen mounds at the Cementerio de Nanchoc site where lime was produced in a controlled ritual context for probable use with coca leaves and/or as a food supplement. While Las Pircas sites were located primarily in the middle and upper reaches of quebrada fans near springs and headwaters of small drainages, Tierra Blanca populations preferred the lower edges of the fans near low terraces or benches above the river. The Tierra Blanca sites are associated with early canals. It is during both the late Las Pircas and the Tierra Blanca phases that we refer to different degrees of household clusters and to co-residential groups with stable foci of residence.

Further, the study area experienced some degree of resource stress during the middle Holocene period as well as changes in social structure during all periods. Based on current evidence, we suggest that the subsistence change from a mobile forager to a sedentary farmer-forager and then to an intensified farmer in the Nanchoc basin was initiated by social and ideological factors and not so much environmental stress and population growth. Further, these changes must relate to the close juxtaposition of multiple ecological zones in the study area (especially the dry and humid forests), some richer than others in resource diversity and abundance, which provided generally higher return rates for both mobile foragers and later mixed foragers and farmers. This type of heterogenous landscape that was patchy and offered a variety of closely ranked and low-cost resources may explain why so few large animals appear in the faunal record of sites.

Curiously, despite the high diversity of dietary species within relatively easy short distances across these multiple zones, agricultural intensification during the Tierra Blanca phase took place in the low-risk zone of the dry forest of the Nanchoc basin.

For reasons not yet well understood, there must have been a need to find a different resource production strategy, which likely initiated the use of domesticated plants during the early to middle Holocene period – a strategy probably already practiced in other Andean areas (likely farther north), and possibly in farther inland regions adjacent to the study area. During the Las Pircas and Tierra Blanca phases, domesticated plants were supplemented by existing foodstuffs within a broad-spectrum diet, though increasingly through time people depended more on food crops. The dietary role of domesticated plants in the early Las Pircas phase foraging-gardening subsistence system was a significant economic component by 9000 BP. While cultivating domesticated plants, the Tierra Blanca people evidently increasingly appreciated the benefit of agriculture as a dietary staple and increased its use. Social inequality among different groups and/or households had developed beginning in the Las Pircas phase, as suggested by the skeletal and exotic material evidence. Emerging social inequality among these foragers/gardeners possibly promoted increased production and exchange of rare status and ritual items, such as purple shells and stingray spines from the coast and other items from the highlands. In the process of increasing social complexity, domesticated plants must have provided an excellent source of status differentiation on the individual and household levels.

It is clear that between ~9,800 and 5,500 years ago, substantial sedentary and highly localized settlements, intensive foraging, house gardening, and diverse patterns of land use came to characterize a particular core area of the upper middle Zaña Valley, in the dry forest of the Nanchoc basin. Perhaps an important pattern is the shift from a variety, albeit low in numbers, of exotics in the Las Pircas phase to their absence in the Tierra Blanca phase. This shift coincides with the building of the two mounds at the Cementerio de Nanchoc site and others in the Zaña Valley, suggesting a change from individualized household accumulation and perhaps competition to public or communal concerns, in this case the ritual production of lime. The impact of this separation may have been to create a special place that served the local community for many generations as a communal and continuing focus for ritual. Of further interest is the interrelationship between the two mounds and the organization of the community that built them. The prevailing assumption is that the labor requirements represent the products

of communal activities and incipient corporate groups (Feldman 2009; Haas and Creamer 2006; Moseley 1975; Sandweiss 2009; Shady 2000, 2005). There is no reason that households, affiliated as a local community, could not periodically unite and cooperate to build structures that the community saw as important. However, there is no evidence to suggest that such cooperative efforts were organized by a formal leadership structure.

In sum, the first people in the Zaña and Jequetepeque Valleys were general foragers, specialized maritime gatherers and hunters, specialized highland hunters, incipient horticulturalists, and other combinations in a wide variety of environmental contexts. These diverse economies entailed different degrees of technological innovation, planning, low-risk management, resource sharing, mobility, territoriality, ritual, and social interaction. We see this as a heterarchical development of relations between different areas to one another whereby each possessed the potential for social and economic growth and for interacting in a number of ways. In other words, heterarchical interaction existed between different kinds of foraging, foraging/gardening, and farming societies where there were many different axes along which differentiation and transformation took place, rather than continuous development in one place, such as the upper middle Zaña Valley and more specifically the Nanchoc basin. However, when viewed from only the perspective of agricultural and community development, the Nanchoc area was clearly more advanced than other parts of the project area (e.g., Q. del Batán and Q. Talambo).

CHAPTER FOURTEEN

Northern Peruvian Early and Middle Preceramic Agriculture in Central and South American Contexts

Dolores Piperno

This volume on early human settlement and agriculture on the lower western Andean slopes of northern Peru synthesizes a veritable mass of data from more than thirty years of fieldwork and research to offer arguably one of the most complete expositions of early and middle Preceramic culture in the Americas. The evidential scope extends to the identification of domestic structures with stone foundations and storage pits, an impressive variety of artifactual remains including well-made stone hoes, landscape features such as garden furrows and irrigation canals, and mound building for public ceremonies. All are well dated through dozens of internally consistent radiocarbon determinations on charcoal, human bone, and plants, revealing a sequence between about 10200 and 5800 BP during which domesticated plants were introduced to the region and food production took hold and intensified (all dates given here are in calibrated radiocarbon years ago). The coverage breadth and data presentation call to mind the classic work *The Early Mesoamerican Village* (Flannery 1976), this time putting Preceramic South American settlements, economies, social spheres, and technological developments in an empirically rich, synthetic perspective.

With particular regard to the beginnings and development of agriculture in the Zaña Valley, there is a variety of empirical data from cultivated and domesticated plant remains, including AMS-dated macro-botanical specimens and starch grains removed from human teeth of directly dated skeletons and jaws. The micro-fossil and macro-fossil records are often mutually reinforcing and they broaden our understanding of how the plants were prepared as foods and consumed. In this chapter, I consider some aspects of how the Zaña Valley sequences compare with those of other regions in Central and South America where farming originated and intensified in scope during the early and early middle Holocene.

THE PLANTS, THEIR SOURCE AREAS, AND TIME LINES OF APPEARANCE

The early cultivated and domesticated plants documented in the Zaña Valley records were all introduced into the study region from elsewhere in South America (see Fig. 14.1 for geographic areas of origin for various South American crops and locations of other archaeological sites where early plant domestication has been documented). Manioc and probably peanuts came from the southwestern periphery of Amazonia; *Cucurbita moschata* squash likely from the north, quite possibly Colombia; pacay (*Inga feullei*) and *Erythroxylum novagranatense* coca from the eastern Andean slopes; cotton likely from coastal southwestern Ecuador or northern Peru; *Phaseolus* (for a number of reasons more likely to be the lima rather than the common bean; see Piperno and Dillehay 2008) and *Chenopodium* from the Andean highlands (see Olsen 2002; Olsen and Schaal 1999; Sanjur et al. 2002; Wessel-Beaver 2000; and Westengen et al. 2005 for further information on some of these crops, and Piperno 2006a,b, in press a,b for recent overviews of the geography of plant domestication in Central and South America). The crops are thus an interesting mixture of lowland and highland representatives, and they arrived from areas east and west of the Andes as well as from northern and southern South America.

The earliest crop incorporated into Preceramic subsistence economies was *Cucurbita moschata* late in the El Palto phase or late Paiján subphase at 10200 BP. During the following Las Pircas phase between about 9700 and 7800 BP, peanuts, *Phaseolus*, pacay, quinoa, and coca first appear, all but coca occurring during the first half of that period and coca near the end of it. Cotton is the last to arrive at 6200 BP during the Tierra Blanca phase. Although we don't have a good idea of what the exact diffusionary routes were for these plants, the geographic breadth of their origin locales provides another indication that during the first two to three thousand years of the Holocene, plant food production arose and took hold over a significant area of South America, either through primary or secondary developments. Research carried out over the past ten to fifteen years in central and western Panama, coastal Ecuador, the Cauca Valley of Colombia, and the Colombian Amazon indicates that *C. moschata* and a number of other South American crops such as *C. ecuadorensis*, *Calathea allouia* (leren), *Maranta arundinacea* (arrowroot), manioc (*Manihot esculenta*), and avocados (*Persea* sp.) were being grown between 10500 and 7600 BP (e.g., Dickau et al. 2007; Gnecco and Aceituno 2006; Mora Castilla 2003;

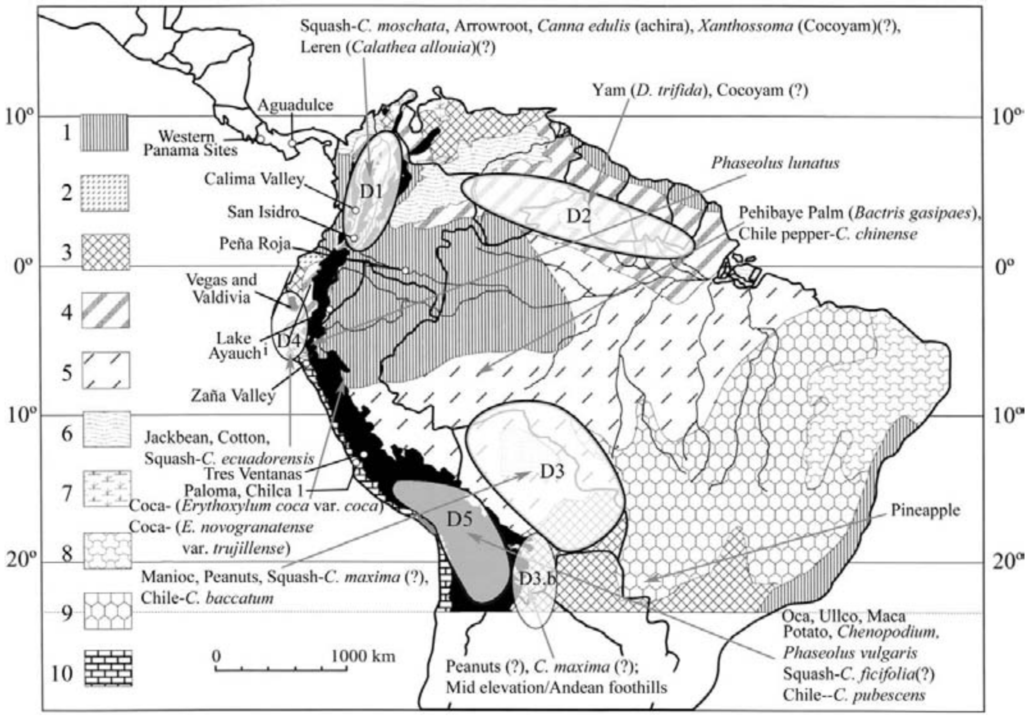


Figure 14.1. Postulated domestication areas for various crops in South America. The ovals in D1-D5 designate areas where it appears that a number of important crops may have originated. Open circles are some archaeological sites where early crop remains are present. See Piperno, in press a and b, for all of the sources used in the figure.
Modern Vegetation Zone Guides for Fig. 14.1: 1. Tropical evergreen forest. 2. Tropical semi-evergreen forest. 3. Tropical deciduous forest. 4. Mixtures of TEF, TSEF, and TDF. 5. Mainly semi-evergreen forest and drier types of evergreen forest. 6. Savanna 7. Thorn scrub. 8. Caatinga. 9. Cerrado. 10. Desert. Black areas indicate mountain zones above 1,500 masl. Modified from Piperno 2006a.

Piperno 2006a,b; Piperno in press a; Piperno and Pearsall 1998; Piperno and Stothert 2003; Piperno et al. 2000).

Various *Cucurbita* species are ubiquitous components of earliest food production in all of these regions (and also in Mesoamerica; e.g., Piperno et al. 2009; Ranere et al. 2009; Smith 1997), usually along with one or more root crops and bottle gourd. (The latter originated from Asia, not Africa as was long thought, and was probably carried from Asia by humans during the early colonization of the New World [Erickson et al. 2005]). *Cucurbita* plants can have uses other than for food (e.g., as containers or net floats), prompting a view that in eastern North America early cultivation and diffusion of *Cucurbita pepo* ssp. *ovifera* were motivated much more by the utility of the plant for its nonfood uses than by its role in the diet (Fritz 1999). However, a number of lines of evidence, including *Cucurbita*

phytolith characteristics indicating selection for softer fruit rinds at sites in Mexico, Panama, and Colombia, and starch grains from *C. moschata* fruit flesh recovered directly from Las Pircas-phase human teeth at the Zaña habitations, indicate that in Central and South America squashes were used at or shortly after their initial cultivation as food plants (e.g., Piperno and Dillehay 2008; Piperno et al. 2009; Piperno in press a).

Cucurbita phytoliths, probably *C. moschata*, occur in Panama, in the Cauca Valley, and in the Colombian Amazon at 9000–8600 BP. Manioc arrived in Panama about 7600 BP and domesticated yam (*Dioscorea trifida*), another lowland northern South American crop, occurs there by about 5800 BP. The now-minor root crop leren was cultivated along with *C. moschata* at 9000 BP in the Colombian Amazon, and both leren and another now-minor root crop, arrowroot, occur with *C. moschata* in central Panama by 9000–8600 BP (see Piperno 2006 b, Dillehay and Piperno in press, and Piperno in press a and b for recent reviews of the lowland and highland evidence).

Therefore, an early core group of seed, root, and tree crops that were cultivated for dietary purposes and were dispersed fairly widely can be identified, although some differences from region to region are apparent in what was cultivated earliest by different cultures, or at least grown persistently enough to make their way into archaeobotanical records. Southwestern Ecuador and the arid coast of Peru provide further information on the dispersals of a larger variety of crops during what were largely Tierra Blanca phase times in the Zaña Valley. Obviously again, minimal ages for when the plants were originally taken under cultivation and domesticated in their original hearths of origin are also provided by these plant remains. *Cucurbita ficifolia*, a squash of the high Andes, and guava (*Psidium guajava*), a lowland tree crop, appear at Paloma, Peru at c. 5800 BP At nearby Chilca I, domesticated lima beans appear by 6400 BP while crops such as *achira* (*Canna edulis*), native to the mid-elevation northern Andes; *jicama* (*Pachyrhizus ahipa*), another highland crop; and jackbean (*Canavalia plagiosperma*) occur by ca. 5000 BP (see Hastorf 1999, 2006; Pearsall 1992, 2008; and Piperno, in press a, for summaries and reviews of this information). The Valdivia cultural sequence of southwestern Ecuador provides evidence for jackbean, achira, and chili peppers in addition to the crops discussed above, and maize is present there by 5500 BP (Pearsall 2003, 2008; Zarillo et al. 2008).

None of the mentioned plants have been documented in the Zaña Valley during Preceramic times. Root crops in particular are far less common in the Zaña assemblages than elsewhere during the ca. 10000 to 6000 BP period, and arrowroot, leren, achira, and yams do not appear at all. There

is an obvious "regional" flavor to early Zaña farming, with some of the plants that would come to typify later fully agricultural systems in the Andean region being already present in the earliest crop systems. It is not unlikely that some of the plants such as arrowroot, leren, avocados, yams, and others known to have been cultivated in northern South America by 6000 BP and not documented in the Zaña sites were known to these people, especially by the end of the Tierra Blanca phase, and that for reasons related to local ecological and demographic factors, to accessibility to the exchange routes through which the plants were moving, or simply to cultural preferences, these inhabitants did not grow them. It appears that regional dietary patterns, whatever their causes, began to emerge not long after food production and crop dispersals began.

A Mesoamerican crop, maize, should also be considered in discussions of early crop movements into the Zaña region. Pollen and phytolith records from archaeological sites located in the Cauca and Porce valleys, Colombia, and southwestern Ecuador appear to firmly document the introduction of maize into northern South America by 7000 BP. Pollen and phytolith evidence from the Colombian and Ecuadorian Amazon indicates that maize was dispersed into those regions by 6000 BP (see Piperno in press a for a review of this evidence and pertinent references). The South American record is fully in accord with recent archaeobotanical evidence from the Central Balsas region of Mexico, the probable hearth of maize domestication, where maize starch grains and phytoliths are present at 8700 BP at the Xihuatoxtla Shelter (Piperno et al. 2009; Ranere et al. 2009). Also, phytolith, starch grain, and pollen records from a variety of sites and cultural contexts indicate that maize was present in Panama by about 7600 BP (e.g., Dickau et al. 2007; Piperno 2006 a; Piperno et al. 2000). Starch grain evidence from ceramic food residues at early Valdivia occupations together with the phytolith records indicate that maize was well integrated into diets there by 6000 BP, forming along with a variety of other domesticated plants a mixed crop system (e.g., Pearsall 2003; Zarillo et al. 2008). Present evidence from the Zaña region indicates initial maize appearance at the terminal Preceramic site of Cerro Guitarra at about 4500 BP. The date of maize entry into coastal Peru has long been under discussion. Maize, of course, isn't the only cultural artifact to appear later than would be expected in the Peruvian coastal area given the chronology of its appearance and routine use not far to the north in coastal Ecuador. Pottery is another notable example.

Evidence on the chronology of Peruvian maize introduction will continue to build, and then we will be better able to assess the possible

influence of diffusion routes, cultural usages of the plant, and other factors affecting when and where maize first made its way into Peru. There is one additional and important point to be made here that concerns the timing of maize movement into South America as a whole. Investigators who continue to seriously question or disregard most to all of the considerable micro-fossil database on maize origins and initial dispersals out of Mexico support their view by claiming that the presently earliest documented maize cobs from Guilá Naquitz Cave, Mexico, dated to 6250 BP, are so "primitive" that domestication must have occurred shortly before, and thus maize movements out of Mexico only afterward (Browman et al. 2009; Staller and Thompson 2002). The Guilá Naquitz cobs are indeed small, but it must be understood that they already represent very significant genetic and morphological transformations from their wild progenitor Balsas teosinte (*Zea mays* ssp. *parviglumis*) – for example, plant and inflorescence architecture, nonshattering ears, two kernels per cupule. Iltis (2006: 29) notes that "we still have only the haziest notions of what the earliest stages of maize domestication might have looked like; for even the oldest, 6250-radiocarbon-years-old, proto-maize ears from Guila Naquitz Cave, are already far advanced." Furthermore, we should not expect 6,000-year-old maize cobs to be the same in size and morphological attributes everywhere they occurred because it cannot be assumed that maize was developed and/or improved in the same ways by different cultures during the roughly 8000 to 5000 BP period. A cardinal attribute of maize is its plasticity and adaptability in different environments, and once removed from proximity to Mexican teosintes, its evolution into a productive crop plant may have taken a different trajectory.

Finally, care must be taken with regard to a presence/absence evaluation of all the different cultivars in various regions discussed here. Even when the spectrum of macro-fossil and micro-fossil evidence is available, which is the case for few of the sites, some cultivated and domesticated crop species may not be visible in records due to issues of preservation, or production, or identification. For example, a number of important tree crops such as guava (*Psidium guajava*, *Annona* species [guanabana, custard apple]), naranjilla (*Solanum quitoense*), and others do not produce identifiable starch grains, or starch at all, so that their absence on the Zaña teeth investigated mean little in assessing whether they were eaten. On the other hand, the plant foods absent from the Zaña teeth, such as the root crops discussed earlier along with *C. ficifolia* squash and jackbean, would be expected to occur in dental starch grain records had they been a part of the diet because they produce high amounts of distinctive starch grains. Through

a multifaceted archaeobotanical database we can approach presence and absence issues with more confidence than we could previously when a single type of plant fossil was studied.

In summary, there is an emergent pattern from the combined evidence for a number of features of early and middle Preceramic agriculture. First, the period between 10000 and 7600 BP saw the initial cultivation and dispersal of a number of crops in southwestern Ecuador, the western Andean slopes of northern Peru, the Colombian Cauca Valley and western Amazon, and as far as the Isthmian Pacific coastal region. Some of the earliest crops identified, such as *C. ecuadorensis*, *C. moschata*, and *Phaseolus,* were probably domesticated not far from the sites in Ecuador, the Cauca Valley, and Zaña Valley, respectively, where they first occur. Others such as manioc and peanuts began their journey from a considerable distance away in southwestern Amazonia. Some of the crops crossed the Andes, or at least one of its ranges, in one direction or another on their way to the regions that provide us with their earliest evidence.

Second, by the close of the sixth millennium BP, many of the earliest cultivated lowland plants were more broadly disseminated through the neotropics and along the Pacific coastal corridor, and additional species of root crops along with chili peppers, jackbeans, and *C. ficifolia* first appear. Maize, *Phaseolus* beans, and squash, likely *C. moschata*, reached as far as southeastern Uruguay by 4000 BP (Iriarte et al. 2004). These cultivars were probably transmitted across an ever-expanding web of social and economic interaction. It might be tempting to see the later appearance of plants such as the jackbean, jicama, and *C. ficifolia* as evidence that they were domesticated as part of expanding and intensifying agricultural developments in their home regions, and thus also begin establishing a firm temporal framework for the origins of a large number of South America crop plants. However, many factors would intervene to make this proposition tenuous, among them that too little information is available from most of their hearths of origin.

THE COMMUNITIES THAT FIRST CULTIVATED AND DOMESTICATED PLANTS

The Zaña and Jequepeteque valleys, along with a number of regions in Mexico, Panama, Colombia, and Ecuador, all share evidence of early food production; these regions have also been the location of multi-year archaeological field projects that included systematic foot survey and excavations of different sites in the same immediate area proven to be occupied at

about the same time (see earlier citations). These aspects provide important information on settlement and social organization together with population numbers through time. Everywhere between 11000 and 7600 BP, the sites are typically rock shelters and/or limited clusters of small, open-air occupations that were located beside secondary watercourses and seasonal streams, whose small stretches of alluvium likely were used for planting gardens. Settlements were typically less than one hectare in size and many were probably occupied seasonally. Settlement organization was often similar to modern, tropical hamlets and hamlet clusters where one to a few nuclear families composed the residential community. The Zaña Valley locations and possibly the Las Vegas, Ecuador, sites were probably occupied year-round during at least the middle to latter part of the 11000–7600 BP period.

Thus, nowhere in Central or South America is early agriculture associated with large or fairly large permanent and nucleated villages situated in major river valleys. It wasn't until millennia later that this occurred (e.g., Pearsall 2003; Raymond 2008). Views on this matter – including the expectation that effective and productive farming should have emerged, and thus only be recognizable to archaeologists in the contexts of pottery making and sedentary villages – were far too long colored by Near Eastern and Chinese developments, which took place under very different ecological and human demographic circumstances.

Our American first farmers were *smaller scale horticulturists* growing a variety of seed, root, and tree crops in small – often home garden – plots; they continued to hunt, gather, and fish while living in small household communities in which no more than one to a few nuclear families shared a residential community and the nuclear family was likely the main unit of production and consumption. It should be pointed out that today in the tropical forest it is still easy to find examples of people who practice similar kinds of horticulture while hunting and fishing, and who derive many of their calories from cultivated and domesticated foodstuffs (e.g., Gurven et al. 2010; Piperno and Pearsall 1998). Another major point of contrast between the Americas and the Near East/China is that some of the earliest South American crops, such as arrowroot and leren, were later destined to become fairly marginal dietary items, as maize and other crops became staples. As more information emerges from around the world – for example, from mainland southeast Asia and India – we may come to see places like the Near East and China as exceptions to the rule and hardly as common exemplars of how food production emerged, took hold, and spread.

FUTURE PROSPECTS

We have obviously learned a great deal about the origins and dispersals of agriculture in South America and elsewhere in the Americas the past fifteen to twenty years. Advances have come about in part from multi-proxy approaches to archaeobotanical investigation, and also from field-work incorporating intensive multi-year foot surveys, detailed excavations, and multidisplinary analyses, as exemplified by the Zaña and Jequetepeque projects. In this region and others, such efforts have led to an understanding of important correlates to early farming, such as settlement strategies/mobility/size and how early farming communities were organized. In the estimation of the author, several priorities for future research would elucidate some of the most pressing and less understood aspects of agricultural origins in South America. These are discussed in the remainder of the chapter.

For a number of important crops, good molecular data are available from living representatives and wild progenitors on the geography of their origins, but archaeological data from their hearths of origins are lacking. This is true, for example, for manioc, peanuts, and some chili peppers, all of which are probably native to the southwestern periphery of the Amazon basin in Brazil or Bolivia. The earliest evidence for these plants is found a considerable distance from where they were originally taken under cultivation and domesticated. Clearly, the geographic region circumscribed by molecular data as the domestication hearth for these and other plants should become a focus of Preceramic period research.

For a larger number of crop species, including some with an early archaeological record, there are no or almost no molecular data that provide information on their origin locales. Root crops such as malanga, yams, arrowroot, achira, and some of the high Andean species are conspicuous here, as well as squashes such as *C. ficifolia*. In some of these cases, field collections of close wild relatives are also inadequate, and putative wild progenitors have not been identified, a situation that then impedes molecular research. It is important to point out that field collecting of plants does not just lead to a better understanding of distributional ranges of wild species that potentially are crop progenitors; it also vitally increases understanding of the amount of land race diversity in the crops themselves. This point is well illustrated by Cucurbitaceae collecting efforts carried out by Thomas Andres, Linda Wessel-Beaver, Michael Nee, and their South American colleagues the past ten years; their work showed considerable and previously unknown land race diversity in *Cucurbita moschata* and other

domesticated squash species and created the modern collections that allowed the *C. moschata* seeds at the Zaña sites to be identified (e.g., Andres et al. 2006; Rosas et al. 2004; Wessel-Beaver 2000). When those seeds were first examined fifteen years ago, they could not be securely assigned to any wild or domesticated species (see Chapter 10).

The list of regions and particular corners of regions where early settlement and agricultural histories should and likely will be elucidated by archaeological research in the next few decades is too long to comment on here. Furthermore, the research in northern Peru done by Dillehay and colleagues shows so well that returning to datasets with newer or improved types of analyses and excavations in previously unexplored sites can be critical for the most complete understanding of problems. It would not be surprising to see reexcavation and reanalysis of a number of important sites in Central and South America that were first discovered and subjected to analysis before modern paleoethnobotanical and other techniques were developed.

What, then, can we expect the next ten to fifteen years from research into the origins of agriculture in South America and in the Americas beyond? I think field and laboratory research efforts will continue to be a combination of the old and the new; nothing novel that comes along will ever substitute for going into the field and making extensive collections of plants of interest, carrying out archaeological foot surveys/excavations with associated multidisciplinary analysis over numbers of years, and constructing large modern reference collections for identifying archaeobotanical remains. At the same time, we can expect analytical improvements in molecular, plant macro-fossil/micro-fossil, and other research that will provide more powerful and precise information. Molecular methods are beginning to be based on high-throughput devices that can simultaneously provide DNA sequence and gene expression data on thousands of areas of a genome at once, and there is no reason to believe these methods cannot be applied to both modern and fossil plants. Refinements will continue to be made in techniques for sampling phytoliths and starch grains from pottery, teeth, and stone tools. The present and the future are bright indeed.

CHAPTER FIFTEEN

Conclusions

Tom D. Dillehay

Our long-term study of Preceramic times in the Zaña and Jequetepeque valleys has not produced a wide-sweeping theory or given attention to a new social process. Nor have we reviewed the database from the perspective of several popular conceptual models, such as optimal foraging theory, self-aggrandizement and wealth accumulation, cost-benefit analysis, and human behavioral ecology in general. Rather than forcing the data into unproven models that often substitute for patterning, we decided to focus our attention on identifying patterns in the archaeological data and on the interpretation of historical events and processes and specific sociocultural and techno-environmental contexts forming larger patterns. In small and large processes of contrast across time and space in the study area, we attempt to offer a synthesized understanding of the exceptional database that we have gathered over the past three decades. This does not necessarily imply a complete abandonment of the use of concepts, for in many places throughout this study we have assessed our findings in regard to broader issues in the areas of plant domestication, human response to environmental change, change stimulated by environmental richness, household and community development, emergent social complexity, the roles of household and public ritual, and related topics.

We perceive this study as being useful on several fronts. First, it has provided a cultural historical and ecological interpretation of one of the largest Preceramic databases produced to date in South America. Our interpretations of these data are based on more than three decades of interdisciplinary research. Second, this volume has been a synthesis of those data. The majority of the raw data and the archaeological and paleoecological patterns drawn from them are available in numerous technical reports (e.g., Dillehay and Eling 1989; Dillehay and Rossen 2002; Dillehay et al. 1998, 1999, 2001, 2003, 2004; Dillehay and Kolata 2000, 2002, 2006;

Netherly and Dillehay 1985), dissertations and theses (Maggard 2010; Rossen 1991; Stackelbeck 2008), and journal articles (e.g., Dillehay and Netherly 1983; Dillehay et al. 1989, 2003 2007, 2008, 2009; Netherly and Dillehay 1985,1986 a,b). In addition to these reports, we also have included new, unpublished data. The data and findings in all of these have been synthesized and cited repeatedly throughout this study.

And third, this study has documented what we consider to be four important patterns. One pattern is the initial entry of people into the study area. We do not know when people first entered northwestern Peru, but we believe that the Fishtail and early Paiján do not represent the earliest archaeological record. Part of that record is likely submerged underwater several kilometers offshore, associated with surface deflated sites in the Carrizal area, buried under several meters of sediments in the foothills and possibly higher elevations, or washed out by earlier glacial and other events. It is most likely that the Fishtail and probably the Paiján points diffused into the area from coastal migrations, if not those associated with populations moving along the western slopes of the Andes. Whichever direction it was, by at least 10800 BP people had become territorial and localized and had begun to cultivate squash and build more permanent house structures, which set the stage for several later social and economic developments. A second is documentation of the transition from early foraging to farming communities. A third is the uneven development of Preceramic societies throughout time across the study area. While some areas such as the Nanchoc Valley boomed socially and culturally during most of the early to middle Holocene period, others never developed beyond a mixed foraging lifeway. As discussed previously, there are probably several reasons for this uneven development that relate to a multitude of shifting environmental, social, economic, and other factors.

A fourth pattern relates to our archaeological expectations. Once a new technology or invention appears for the first time in an area, such as canal irrigation or crop use, archaeologists far too often expect its benefits to be obvious to all local residents, resulting in its quick spread across all settlements in contact. But this is not always the case, as we have seen in the Zaña and Jequetepeque valleys with respect to the adoption of cultigens, canal irrigation, mound building, and permanent domestic architecture. For instance, despite the identification of early crop production within the project area, it developed in a fragmented foraging setting consisting of distinct types of hunters and gatherers, only some of whom adopted it. We currently do not know why this occurred. Perhaps some settlements simply did not envision the benefits of new technologies, rejected them

outright, or did not have the know-how to incorporate them. Perhaps the relative environmental richness and stability of the resource-rich seasonally dry forest in the Nanchoc area encouraged low-risk social and culture change.

Thus, the commonly perceived initial "wave of advance" or "globalization of agriculture" during the early Holocene period (cf. Barker 2006; Bellwood 2004; Garcea 2004; Kennett and Winterhalder 2006; Richerson and Boyd 2000), which generally presents the spread and adoption of agriculture as a given, was not evident in our area, at least not at the local and regional scales of analysis and probably not for most of the continent. Our thought is that the introduction of some new cultural item, be it a crop or a new tool technology, provoked a resonance, either positive or negative, among foragers and incipient farmers in the Zaña and Jequetepeque valleys – it activated a cultural potential or latency. That is, local groups may have adopted it and used it according to local perceptions, or they may have rejected it. Even when plants were cultivated, particular species like *Cucurbita* sp. and *Arachis* sp. did not become immediately widespread cultigens across the study area (or even the Andes). Instead, our data reveal that the adoption of agriculture was a slow and selective process. The simple fact is that new knowledge and new products were not always incorporated by all settlements through time and space. A new idea or technology may have been unheeded or rejected because it was not relevant or needed at the time – it simply found no resonance among the majority of foragers in the study area. While plant cultivation developed as a low-risk experiment in one Zaña Valley zone, the Nanchoc basin, it did not appear immediately in other areas. This implies that during late Las Pircas and Tierra Blanca times, societal and cultural variability was characterized by different types of contemporaneous simple foragers, complex foragers, farmers, and fishers. Thus, rather than cultural uniformity having been the hallmark of the early to late Preceramic period, it was instead cultural diversity. Not until 5,000 to 4,000 years ago did intensive agricultural practices spread more vigorously and effectively across most of the study area and beyond.

Why did some developments, such as permanent houses, public mounds, and communal canals and agriculture, take root in some areas, but appear later or not at all in others? Hunters and gatherers of the Las Pircas and Tierra Blanca phases not living in the Nanchoc Valley must have been aware of the farming practices there, but perhaps they were reluctant to change their way of life. That reluctance might have been because of reservations about the farming lifestyle and its commitment to sedentism and to a

particular plot of land, or it could have been because the local environment was so productive in some areas, such as the seashore and nearby marine estuaries and the *algarrobo* and other forests on the coastal plains and in the lower foothills, that there was little need or incentive to experiment with new ways of obtaining (i.e., producing) food. In the first case, the growing exposure to a farming way of life and material culture might have led to internal tensions and the growth of social differentiation. If so, the adoption of farming could have been a social strategy implemented to build social differentiation. These possibilities are suggested by the presence of mutilated human bones and possibly cannibalism in late Las Pircas and some later Tierra Blanca sites and by differences in house sizes and the content of artifacts in them (see Chapter 8: cf. Rossen 1991; Rossen and Dillehay 2001b).

With further respect to agriculture, perhaps there was not enough water in some areas to sustain intensive farming. A certain natural habitat with an ample supply of water and a variety of wild and/or domesticated plants is needed to permit experimentation with cultigens. For instance, the Nanchoc region offered both dry and moist forests that were productive during the Las Pircas and Tierra Blanca phases while lower elevated areas were likely drier. A hypothetical scenario is that the adoption of cultigens was the result of adverse circumstances as the economic prosperity of local foragers in more arid places might have been threatened by reduced food supplies. The possibility also exists that rich ecotones such as Nanchoc allowed plant cultivation to begin as a low-risk activity (Rossen 1991). In areas such as the Q. del Batán and Q. Talambo, where there was an abundance and year-round supply of *algarrobo* pods, some cacti fruits and leaves, snails, and other wild resources, there might have been less incentive to adopt agriculture.

As noted earlier, there may be sampling problems in the archaeological record of the project area. That is, more cultigens may become visible at lower elevated sites when more phytolith and starch grain analyses are performed on cultural sediments from them. But we doubt whether sampling bias is a major factor in all areas because the best organic preservation occurs in sites of the drier, lower elevated zones. Also, missing or minimally present at the majority of lower elevated sites are the corollary indicators of crop production: storage units, waisted hoes, large and numerous grinding stones, canals, and other agricultural features.

Consideration of the uneven spread, adoption, and development of technologies and societies across the Zaña and Jequetepeque valleys (and beyond) implicates a variety of processes and behavioral phenomena,

ranging from environmental and dietary differences to the sizes of social groups to patterns of interaction among individual households within those groups, and the relationship among cognition, sociality, ideology, and technology. Yet, regardless of the variables involved, we must remember that the transmission of technological information through observation, imitation, and learning had to have taken place within specific social (Ingold 1993) and physical settings.

Beginning in the late Paiján subphase, Preceramic society in the Zaña and Jequetepeque valleys was dominated by a diverse physical and cultural landscape where the contrast was pronounced between a few settled households in the Nanchoc, Q. del Batán, Q. Talambo, and Q. del Examen and numerous large and small temporary campsites and semi-permanent localities in other areas. This distinction is important because it brings out the reality of the cultural diversity inferred in the archaeological record itself – that is, contemporaneous long- and short-term base camps, long- and short-term field camps, processing stations, transitory station/workshops, lithic quarries, proto-households and kitchen gardens, households and communal agricultural fields, and/or mounds – existing simultaneously in several different areas, each site category and its resident population having its own cultural resonance.

Moreover, from the archaeological record we can infer that the landscape during the Las Pircas and Tierra Blanca phases was one where a few aggregated household communities like those in the Nanchoc basin existed, surrounded by smaller disaggregated campsites within a radius of several kilometers, either providing exchange services or in contact with those communities, situated in between all of which were empty to near-empty valley floors and quebrada fans, such as those documented in the Q. Examen, Pampas de Mata Indio, Pampas de la Cantarilla, and others in the Zaña Valley (see Fig. 1.2). Over the centuries leading up to the terminal Preceramic period between ~5500 and 5000 BP, when permanent settlements are found in more areas of the Zaña and Jequetepeque valleys, these nearly empty landscapes were progressively exploited if not gradually occupied. However, the variability of different site types associated with the variability of the vertical landscape in the study area never came under unifying and homogenizing tendencies until the late Formative period ~4000–3500 BP, and this was only partially achieved by processes imposed by increased population growth, agricultural intensification, public ritual at several ceremonial centers, and probably the rise of a formal leadership structure (Burger 1992; Dillehay 2004; Ravines 1985; Tellenbach 1986; Zeidler 1998).

We are not implying a hierarchy of settlements during the Las Pircas and Tierra Blanca phases though they differed in size, economic function, degree of permanency, and probably social status and intensification. When we inspect the quality of the archaeological evidence site category by site category with an eye on its chronology, it is necessary to realize that even by the terminal Tierra Blanca phase (~5000 BP), we still do not have evidence of agglutinated agricultural villages in the two valleys. A village lifeway did not develop until after late Preceramic and early Initial Period ceremonial centers already had appeared in other regions (e.g., Norte Chico to the south), and this took place in only two terminal Preceramic (or aceramic) localities in our study area, Cerro Guitarra in the lower Zaña Valley and possibly Quebrada de la Salina (JE-734) in the middle Jequetepeque Valley. Not known are the conditions that led to a village lifeway at these two localities, but they appear to date (~4000–3500 BP) just before or slightly after the appearance of maize in the valley and the development of early ceramic period mound centers at Purulén in the lower Zaña Valley (Alva Alva 1988), San Luis in the middle Zaña Valley (Dillehay 2004), and several localities in the Tembladera area of the Jequetepeque Valley (Ravines 1985; Tellenbach 1986). Whatever may have been the combination of stimuli responsible for the appearance of these two villages in the study area, it is clear that three distinct stages of development occurred before them. These are (1) an exploratory phase when groups of the El Palto phase, and specifically the late Paiján subphase experimented with crops (e.g., squash) but never settled permanently, although they established proto-households; (2) a settling in phase when advanced foragers on their way to becoming the first farmers, equipped with some crops (e.g., peanuts, squash, manioc, quinoa), initiated permanent colonization, household gardening, and incipient mound building in the Nanchoc area, as best represented by the Las Pircas phase; and (3) a phase marked by agricultural intensification, multi-household cooperation, mound building, and the development of more sociocultural complexity, as defined by the Tierra Blanca phase. In the second stage, permanent circular huts appeared that represent a denser clustering of people in permanent households than before in the El Palto phase. For this to have happened, there must have been a major shift not just in the economy but also in social relationships. That is, household clusters and garden/household-based ritual in the dry forest of the Las Pircas area must have grown to a certain size, probably with a certain degree of cooperation among people, which was manifested in the initial mound building that took place at the Cementerio de Nanchoc site late in the same period. Cooperation in

building the mounds required sharing, a household kinship structure, public ritual at the site, and a mechanism of tension resolution or defense against others, and probably situational leadership. These conditions appear to have emerged during the late portion of the Las Pircas phase only in the Nanchoc Valley. These developments occurred in advance of the third stage, one marked by the appearance of an expanded and more mature material infrastructure, with larger, public ritual related to the technology of lime production and coca use at the expanded Cementerio de Nanchoc site; larger and rectangular houses; more crops, including cotton as an industrial crop; irrigation canals; and greater settlement aggregation during the Tierra Blanca phase. At the same time that these developments were occurring, fewer were occurring in places such as Q. del Batán and Q. Talambo, although domestic architectural structures of both the Las Pircas and Tierra Blanca phases exist in these areas. In other sectors of the area, such as the coast and desert plains and other lateral quebradas, none of the advanced developments occurred.

RITUAL AND TECHNOLOGY

At this point, we need to construct a working hypothesis that will provide a better framework for discussion of the relationship between ritual practices and new technologies in the Las Pircas and Tierra Blanca phases. During the time of incipient household community development of the Las Pircas phase and its maturation during the Tierra Blanca phase, groups in the Nanchoc area were increasingly supported by agriculture and by an aggregating population, and in some areas they probably began to encroach upon each other. Limited conflict may have occurred, as suggested by the fragmented human skeletal evidence during both phases, though the quality and nature of this varies between the two phases. Some late Las Pircas communities – perhaps favored by access to rich resources, regularly practicing communal rituals at special places like the Cementerio de Nanchoc site, and/or having larger group sizes, also like those in the Nanchoc area and perhaps in the more humid drainages of the upper Q. del Batán and Q. Talambo – may have made themselves the center of attraction for neighboring foragers. That is, by attracting contacts with others in neighboring quebradas and valleys, they may have become the focus of ritual and social activity at the Cementerio de Nanchoc site, creating markers for exchange goods from nearby areas and providing minimal security, for the initial establishment of long-distance contacts. The exotic items found in Las Pircas houses seem to point in this direction, although

these slightly predate the construction of the Cementerio de Nanchoc site. This process began with households of the Las Pircas phase but, for reasons currently not understood, apparently did not continue with those of the Tierra Blanca phase, and never moved to a public place like the Cementerio de Nanchoc site. The absence of exotics in houses and the expansion and elaboration of the Cementerio de Nanchoc mounds during the Tierra Blanca phase suggest a period of local isolation, introspection, and development, with little, if any, long-distance exchange and contact with outsiders, a topic discussed in more detail later in the chapter. This constitutes a bare hypothesis for the beginning of household community formations that were initially characterized by aggregation, agriculture, and isolation in the Nanchoc basin.

Within this process, public activity at the Nanchoc mounds during the late Las Pircas and Tierra Blanca phases, with its ritual overtones, must have functioned to perform specific social situations that fostered settlement aggregation. It is this feature coupled with the adoption of crops and an increased dependence on agriculture that sets the seasonally dry forest zone of the Nanchoc basin apart from other sectors of the study area. Essentially, our argument is that household communities in the Nanchoc basin arose originally in the context of house gardening and then primarily in the contexts of irrigation agriculture and an external place for public or communal activity. This could have taken many forms, but developed along lines of public ritual (but not necessarily feasting), one associated with the specialized technological production of lime for use with coca leaves (Dillehay et al. 1989).

This pattern of public ritual seems to have repeated itself later at the Cerro Guitarra site where the first agglutinated mixed economy village (e.g., marine resources and crops) formed alongside a small public plaza sometime after 4000 BP. Some communities, such as Nanchoc and later Cerro Guitarra, were more creative and developed more than their fellow settlements in the study area, as evidenced by their special organizational qualities, by their strategic locations, and, in the case of Nanchoc, by their special agricultural and technological know-how. Evidently, these communities maintained their edge over others in their own sociocultural stock for a long time; other settlements in the study area eventually may have in the course of time accepted ritual cooperation so as to obtain a share in the exploitation of local products such as coca and lime or other products, rather than engaging in competition. This ritual exploitation gradually may have evolved into intermittent social conflict and even subordination rather than cooperation or product exchange. This may be suggested by

the absence of exotic exchange goods and by the presence of heavily mutilated and trampled human remains in Tierra Blanca sites, the latter of which may represent those of distant others who were subordinated and treated differently from local Nanchoc residents. This pattern may have continued as suggested at the later Cerro Guitarra site where no exotics were recovered from excavated houses. No human skeletal remains in disarticulated or articulated form were recovered at Cerro Guitarra.

The succession of the Las Pircas and Tierra Blanca stages is masked by the fact that not all of the technical advances of the latter stage had to wait until then to be invented. Some cultivated areas in the form of household garden plots, ditch canals, and the initial layers of the Cementerio de Nanchoc mounds had appeared in the late Las Pircas phase, but they found more development and communal application and resonance during the Tierra Blanca multi-household agriculture and public places. Furthermore, some expressions of the Las Pircas phase like garden magic (i.e., presence of rock crystals in house gardens) and careful cutting and placement of human bone were abandoned or degraded during the Tierra Blanca phase, although rock crystals were now placed in the mounds at the Cementerio de Nanchoc and not in house gardens. Thus, mature community development, with an aggregating population and technical advances during the latter phase, involved not so much new inventions as the expansion, alteration, and improvement of existing technologies whose time had come.

It also should be noted that the successful integration of a number of households into the Tierra Blanca community had to have been a process requiring a reorientation socially and a different worldview. The type of Las Pircas rituals that first appeared in individual households and shifted away from single households to the multiple household activity at the communal CA-09–04 mounds during the Tierra Blanca phase was likely recreated and enhanced into a stronger integrating community framework. If individual households were increasingly absorbed within an expanding public community during this phase – which is suggested archaeologically by the higher number of household sites aggregating near the communal irrigation canal and the agricultural field near the Nanchoc River and by rituals shifting to the mounds – a different type of beneficial scheme must have come into play. This was where lime production as a ritualized technological activity must have begun: it served the needs of integration *within* the local community and, as discussed later, isolated and bounded the community by binding it to the mounds. We suspect that some of the Las Pircas and Tierra Blanca phase sites located within other sectors of

the study area (e.g., Q. del Batán and Q. Talambo) likely represent the beginning stages of similar but slightly later public social and economic processes.

The simultaneous technological and ritual practices at the Nanchoc mounds require further consideration. As discussed previously, ritual is evidenced at Nanchoc by the construction of the multitiered mounds as isolated public places, by the association of these features with a specialized and isolated activity, and by the presence of rock crystals on the use surfaces of internal mound layers. Rock crystals are known to be sacred objects in the ethnographic Andean and Amazonian worlds and were earlier used in Las Pircas phase house gardens (see Brown 1985; Rossen 1991: see Chapter 5). The mounds were integral to the spectrum of social, technological, and ideological transformations that accompanied the beginnings of farming and inter-household communal activities. But what was their relationship to this process? Were they in some way fundamental to the adoption of farming, or merely a ritual mantle draped over a process of local economic innovation in the form of lime production and coca consumption? The actual building and layering of the two mounds were parallel to the procurement, processing, and preparation of lime. Lime production thus was a stage in a chain of technical steps linked by planning the production process and by the social relationships through which work was mobilized. It obligated local people to work as an extended, albeit part-time corporate group within the Nanchoc basin and across the community in the same fashion they did in building and maintaining the agricultural canal and fields. Further, the lower layers of the mounds were built in the late Las Pircas phase, before the appearance of canals and fields. Hence, the practice of communal labor activities at a place beyond the individual household level was already embedded in the local society through ritual practice and lime production at the mound site, which later required only transfer and retraining to the construction and maintenance of the agricultural features. It seems that small groups of households, living together permanently in the basin during the early Tierra Blanca phase, developed certain ritual and technological habits to create a special product for the consumption of a special item – coca – and to deal with their local communal development.

One final point merits emphasis: although our excavations were limited, we have no concrete evidence in the form of food remains, human burials, special hearths, and containers to indicate that ritual feasting took place at the Nanchoc mounds. Instead, the rituals carried out there seem to be related exclusively to the mobilization of local labor for solidarity and

the communal production of lime. We thus associate the Cementerio de Nanchoc site with *ritualized technology* rather than *ritualized feasts* (Dillehay et al. 1997).

SOCIAL UNITS AND LEVELS

With the exception of the bifacial Fishtail and Paiján points, ground stone tools, and the stone-lined huts of the late Paiján subphase, the El Palto technology was simple, portable, and general in purpose. Social organization also was probably simple, with built-in flexibility that permitted groups to adjust quickly to changing resource needs. The elemental unit was probably a small extended family (perhaps the beginnings of a lineage unit?), organized to be a self-sufficient economic unit, as suggested by the relatively small size of the hut structures and their numbers, from two to eight at late Paiján sites. These may be families that aggregated and disaggregated all year according to resource availability and social needs, with unification occurring at least during some seasons into long-term and short-term camps with several families, which may be represented by sites with more than two to three proto-household huts. Some people probably had small garden plots at the end of this phase, as suggested by the presence of squash at Tierra Blanca sites (see Chapters 6 and 9), but unlike the later phases we have no archaeological evidence of plots. We also suspect that the long- and short-term base camps varied widely in size, ranging from 100 m^2 to 2,000 m^2. If rituals existed in these camps, which they likely did, we found no evidence of them in the archaeological record. Leadership was probably informal, and decisions reached through consensus.

Evidence from the following Las Pircas phase suggests that changes in social structure occurred. The disarticulated and articulated human remains, and the differential distribution of long-distance exotics, including cultigens, suggest social differentiation (see Chapters 5 and 9). Las Pircas people built more elaborate and slightly larger elliptical houses than did the El Palto people, although none aggregated spatially as tightly as they did during the late Paiján subphase. Disaggregation is probably associated with the appearance of permanent house gardens and food production, as more space was likely required by each household. Not known is how long people stayed in these structures (though the thickness of middens associated with house floors suggests longer term residency than during late Paiján phase; see Chapters 4 and 5).

Las Pircas communities are small and made up of five to fifteen households that were separated by 100 to 400 m. The houses remained close

enough for visiting, food sharing, and mutual aid, but each probably acted somewhat independently as suggested by individual storage bins and house gardens. Being semisedentary to sedentary, the Las Pircas structures have thicker floors, and larger and more permanent hearths and storage bins than the earlier ones (see Chapter 4). The family was probably a nuclear group living in a single structure. Except for a loose sense of home range and the house garden plots, the individual household economy and social organization were likely organized in a loosely aggregated community for sharing and protection. When households collaborated, it likely was to obtain or distribute food, or during the latest portion of the phase, to defend themselves against outsiders during times of intergroup social tension, perhaps as suggested by mutilated skeleton evidence, and to design and build the first layers of the Nanchoc mounds. If there were any lines of authority and status among households, they probably materialized in these kinds of cooperative ventures. Las Pircas people probably did not "own" property except for the few exotics or curiosities found on the floors of individual huts. Leadership may have been informal and situational. There is some evidence of gender differentiation, as suggested by the articulated and disarticulated mortuary practices focused solely on males (Rossen 1991).

During the Tierra Blanca phase, the nuclear family probably remained the primary kinship group by which social life was integrated and structured. Much like those of the Las Pircas phase, these families were in single households but they lived in a spatially closer community. The smallest grouping appears to have five to ten houses, which collectively were probably cohabitating nuclear families occupying a single community. (At site CA-09–77, several nearly agglutinated houses are present, suggesting a slightly different and perhaps more closely knit grouping; see Chapters 5, 6 and 11). A greater degree of sedentism is indicated by segmented rectangular houses with thicker floors indicative of long-term occupation. Near the communities are areas that have been domesticated in a zone of intensive use as defined by the communal agricultural fields and canals alongside the south bank of the Nanchoc River. As noted earlier, there was no evidence for exchange of exotics to suggest alliances and exchange partners. Rather, the evidence suggests an introspective or inward looking community focused on localization, increased aggregation, and self-integration. The absence of exotics in Tierra Blanca sites does not necessarily indicate an absence of social relations with outsiders.

The Tierra Blanca phase shows both continuity in isolated households and institutional developments beyond the household level of production and cooperation. Although the household and the household cluster

remained central for most aspects of production and consumption, the increasing complexity of the phase gave rise to new levels of integration and innovation. The most dramatic ones are the slightly more clustered houses, the new infrastructure and movement away from individual garden plots toward communal agricultural lands, and the wider ritual and agricultural community that united households for purposes of occasional corporate labor projects and perhaps mutual defense. We do not know whether this shift to agriculture led to restricted access to and competition over resources, small group territories, and conflict. The presence of available, largely unoccupied lands and active streams within short distances of 5 to 20 km, however, suggests that this is not the case and there was no apparent population pressure placed on resources.

The bottom line is that in these communities, new types of social structures probably guided interaction within and between household groups to develop and take on fundamental roles in the maintenance of the community. The foundation of the household as a permanent social group and its endurance through time, evidenced through the archaeological remains of houses, is one of the most important transitions of the Preceramic period. This follows from the writings of Wilson, who states, "Domestication creates certain elementary and minimum conditions of empirical 'unit' independence or privacy in the sense that the household is physically, economically . . . and to some extent sensorily separated from other households" (Wilson 1988: 97).

SUPRA-HOUSEHOLD LEVEL

The construction and management of public works (i.e., mounds and irrigation canals) during the late Las Pircas and Tierra Blanca phases are seen as either egalitarian or nonegalitarian projects that integrated groups, enhanced communal group identity, and served to ritually and spatially separate not only local but perhaps external groups as well. In the Nanchoc area, we believe that necessary public works led to the creation and consolidation of a community identity beyond immediate individual household gardeners to multi-household irrigation agriculturalists. The central foci of public monuments and places integrated previously dispersed household groupings. Eventually, such places may have served local communities for many generations as a continuing focus for social memory and public ritual beyond the household and community levels.

The institutional elaboration of the mounds and the canal building appear as logical extensions of an ever-increasing localization program of

increasingly aggregated households necessitated by deliberate social decisions designed to create a local community. The communal labor required to build the mounds and the rituals periodically enacted at them functioned to define the local community and its achieved creative landscape. It also may be that the Nanchoc mounds and the absence of exotics during this phase were mechanisms not for including greater numbers of groups by focusing them in public ceremony but for excluding others by defining a locally bounded social community centered on the economic production of lime and various food crops and the social and corporate labor production of local solidarity. This idea runs counter to what we know about public ceremonialism from ethnographic and archaeological studies (e.g., Geertz 1980; cf. Burger 1992; Moseley 1975), which show that public ceremonialism is closely related to occasions of aggregation and centralization. Although ceremony can be important to a larger group because it can offset tendencies in the group to disaggregate from internal tensions, it also can be employed to define and integrate the local community and thus to establish boundaries between it and others. Territorial and resource defense also may have been critical for the Tierra Blanca people who depended on local and perhaps restricted water and agriculture.

LANDSCAPES AND THRESHOLDS

We identify both early pre-complex and later complex mixed forager and farmer behaviors as not just responses to the natural environment but also as strategic social choices among a variety of feasible options in which intersocietal relations were critical variables. From the El Palto phase to the Tierra Blanca phase, we envision an increasingly interdependent relationship between the created social landscape and the built physical landscape in the Nanchoc basin that reminds us of similar developments documented for various ethnographic foragers and farmers (cf. Morgan 2010: 78–80). For example, Gow (1995) has demonstrated how social landscapes and reciprocal kinship relations are closely linked among several Amazonian groups living along the lower Urubamba River. It is the communal activities and duties of kin groups that construct and alter the landscape as kinsmen perform certain ritual and economic tasks, especially through the conversion of the natural tropical forest into domesticated spaces (e.g., houses and gardens). The task of transforming the landscape closely ties together individuals and kin groups and links them to specific places and reciprocal obligations. When foragers begin to create these kinds of socionatural

landscapes and commit kinship linkages to them, a threshold is reached whereby the space of individual households and their garden plots, as well as the surrounding resource zones exploited by the households, are surpassed to form an inter-household community given to the larger entity of responsibilities and rights affiliated with the transformed landscape. This type of threshold was crossed by the Las Pircas people in the Nanchoc basin when they formed a semi-aggregated community and built the first layers of the Nanchoc mounds.

Another ethnographic case is specific to the Las Pircas phase. The scattered domestic sites that make up loosely knit communities of the Aguaruna Jivaro of eastern Peru (Brown 1985) are similar in size and design to the Las Pircas sites, with single houses and their gardens and storage structures situated nearby. The Aguaruna Jivaro practice of placing objects in gardens to perform garden magic formed the basis of interpreting quartz crystals in the furrowed areas of the Las Pircas sites (Rossen 1991). Furthermore, Jivaro garden songs, symbolic blood, and gardens as sacred spaces are similar to the ritual process inferred for the Las Pircas phase when plants were cultivated in close proximity to the houses.

Another threshold reached by the foragers and agriculturalists of Nanchoc may be related to communicating ancestral rights to land and resources. Sedentary agricultural communities like those of the Las Pircas and Tierra Blanca phases were limited to the lands immediately surrounding them for their primary resources, especially for active springs and streams and fertile garden plots. The desire to keep outsiders from seizing these lands could have been strong, especially in a circumscribed or competitive region like the Nanchoc Valley, and various mechanisms could have been derived to secure land rights and to reduce intergroup tensions. Again, in drawing on the ethnographic literature to suggest a similar case for the Nanchoc area, the Wamira people of Papua New Guinea relate their socially constructed places to the origin tales of their ancestors. By associating ancestral history with special places that are repeatedly visited and curated, Wamira individuals, families, and clans strengthen their specific claims to and identities with land and resource rights (Kahn 1996). Claims to resources are defined and recognized by placing houses and sacred protective stones in them. The stones symbolize the history of individuals and groups and how they altered and protected the landscape and inherited rights to it. We envision the dual mounds at the Cementerio de Nanchoc as having served in a similar capacity, whereby the repeated construction phases and periodic ceremonies given to this special space and place

must have united past and present generations and tied the community to the entire built landscape, not just including the mounds but also the agricultural fields and canals and houses.

Furthermore, among many indigenous peoples the justification for historical inheritance rights to resources is physically signaled by burying deceased ancestors on claimed lands. For example, the Berawan of Borneo protect their land rights from generation to generation (Metcalf and Huntington 1991) by building and marking elaborate graves for deceased individuals. Tomb construction strengthens intragroup solidarity and leadership, because conflict can lead to split settlements resulting in smaller residential groups more susceptible to raiding. An elaborately marked grave of an important person thus represents intergenerational sustainability of a group.

We see the recurring placement of cultural layers and the rituals performed at the Nanchoc mounds as having functioned in a similar fashion, whereby generation after generation of communities were tied to the local landscape. (These rituals were first carried out at household gardens and later transferred to the public Nanchoc mounds. Continuity from generation to generation is suggested by the presence of deliberately placed rock crystals in both the gardens and mounds. This represents two different kinds of rituals in two different foci, one initially focused on household gardening and the other on communal production of lime and probably other as yet archaeologically unrecorded activities.) At this point, rather than graveyards representing ancestors, the mounds not only marked claims to the modified landscape but to a commonplace of ancestral identity and a sense of belonging. This, in turn, is somewhat reminiscent of Tilley's notion of the meaning attached to landscape for the Mesolithic period in Great Britain:

> Ancestral connections between living populations and the past were embodied in the Being of the landscape and an emotional attachment to place that had a generalized power and significance in relation to human activities as a series of known, named, and significant places linked by paths of movement to which populations repeatedly returned during their seasonal activity rounds. (Tilley 1994: 202, cited in Morgan 2010: 80)

Although there is no evidence to indicate that the Preceramic people of Nanchoc buried their dead in the mounds, "ancestral connections" could have formed during repeated construction phases and rituals, which would have imbued the place with social memory of and connectivity to the past and to the future, although there is no hard evidence to support this

conjecture. Mound building at Nanchoc thus represented a movement away from burial of the dead higher in the lateral quebradas of Las Pircas and Tierra Blanca. It not only altered the natural landscape and gave the local community ideological and cultural meaning but linked it to a built social landscape as well. Collectively, the social and natural landscapes must have been instrumental in shaping the subsistence practices, memories, and connections to the ancestors for the Nanchoc people, and embodied those people's identity. As the mounds grew in size and the nearby agricultural fields and canals were built, these visible but socially and economically integrated features were physically experienced by the area's inhabitants, who probably recognized the significance of these material markers as signs for social permanence that distinguished the built social community from its natural surroundings and from its neighboring forager communities, which had not yet adopted or reached this threshold of development.

In summary, the appearance of early and simple elliptical structures during the late Paiján subphase, which aggregated in number between two and eight in several sites, and then the later larger elliptical and isolated Las Pircas houses associated with house gardens, probably garden magic, and ritualistic dismemberment of the dead mark an important threshold that signals increased social formality, a greater commitment to crop production, and a different way of engaging with materiality and the built environment in this setting. The construction and maintenance of irrigation canals and the two mounds at the Cementerio de Nanchoc site, and the later shift to larger segmented rectangular houses during the Tierra Blanca phase marked the passing of a major threshold whereby people made a commitment not only to intensified agriculture but also to the associated technological, ritual, and social organization of food and industrial (i.e., cotton) crop production. This latter threshold defined the change from individual household "dooryard horticulture" (Pearsall and Piperno 1998), small-scale intervention in the local landscape, and also probably relocating and tending plants during the Las Pircas phase to communal agriculture, large-scale modification of the local landscape, and the deliberate procurement of food and industrial crops during the Tierra Blanca phase. None of these changes in the study area appear to be associated with direct colonization by farmers but a gradual process of diffusion of ideas (and probably some invention associated with the canals and lime production) into the area and change at the household and community levels. Despite potential social tensions, it was evident that the people of Nanchoc opted for increased aggregation through time and its presumed richer and more varied social and cognitive experience. One way to achieve this was to

locate a public project in a neutral space well beyond individual households – that place was the Cementerio de Nanchoc site. Set within this context, one thing is clear. If there ever were resource, population, social, or other pressures placed on the Nanchoc people during times of stress, they could have moved into empty or nearly empty neighboring quebradas anywhere along the slopes of the lower Andes, but they evidently chose not to. The empirical archaeological evidence is straightforward and visible: during the Las Pircas and Tierra Blanca phases in the Nanchoc area people decided to live together whatever social and natural conditions existed. Early permanent aggregated communities occur in only the tropical dry forest of the Nanchoc basin.

BRIDGEHEAD COMMUNITIES AND INTERGROUP FRONTS

It is now worthwhile to take account of a wider view of the study area. One of the principal problems most likely confronting the emerging agricultural community at Nanchoc was that of dealing with neighboring foraging groups operating with different degrees of mobility, multiple economies, and changing social networks. We can envision the possible cross-cutting and probable constantly shifting settlement and interaction categories that likely made up the variable networks and affinities, and that regulated the dynamics of intergroup social action in all phases. We also believe we can refer to the emerging self-contained creative community at Nanchoc during the Las Pircas and Tierra Blanca phases as *bridgehead* communities. To us, these bridgehead communities had varying relationships of social and economic networks with others that shared the same broad cultural stock. If the creative Nanchoc communities established a marked advantage in the control of resources, technologies, and public events, which appears to have been the case, others likely found it to their advantage to have linked themselves to this community by cooperating with it, rather than avoiding or competing with it by attempting to establish a similar separate community, albeit skeletal evidence of possible conflict.

But cooperation probably did not come naturally or easily to any of these communities. It must have placed heavy demands upon the ritual institution by which the communities at Nanchoc recognized their unity, identity, and distinctness across the study area and beyond. This process began during the late Las Pircas phase, and it accelerated and was reformulated during the Tierra Blanca phase. Local leaders could have emerged under these circumstances, particularly by sponsoring and organizing communal events of lime production and coca harvesting at the Nanchoc mounds and

maintaining the canals and agricultural fields during the latter phase. In organizing labor for such community projects, a leader would have added value to the wider labor force by organizing it so as to help build the community, if not inter-community, a benefit that could not otherwise have been obtained. In the centuries following the Las Pircas phase the most convincing evidence for this process is found in the Nanchoc mounds. The necessary construction and production process revealed there would have required the part-time labor of several cooperating households. (This also is true of the construction, maintenance, and use of the irrigation canals present during the Tierra Blanca phase.) As expressed earlier, these rituals would implicitly have appealed to local cultural unity and social cohesiveness perhaps as a way of avoiding internal tension, drawing fronts or boundaries between the locals and outsiders, as interpreted for the Tierra Blanca phase, and expressing claims of landscape identity in symbolic form. Individual households may have gained rights to particular land plots by investing labor in them. Thus, individual identities would have been created by taking collective land and clearing and planting it, and community identities formed by constructing public places such as the Nanchoc mounds. In the meantime, while these transformations were occurring in the Nanchoc basin, few, if any, similar changes were taking place in Q. del Batán, Q. Talambo, and other areas. Inhabitants here continued to practice a broad spectrum foraging lifestyle, perhaps mixed with a little cultivation in some areas.

The notion of *intergroup fronts* might prove to be most useful to describe multiple occupational experiences and interaction zones that likely resulted from the staggered expansion and uneven transformation of several different systems of foraging food procurement and farmer food production operating at the same time in the study area during the Las Pircas and Tierra Blanca phases. The degree to which forager and farmer groups in any of the specific environmental zones within the study area were encapsulated – that is, territorially confined and socially subordinate to farming neighbors – is an important question to consider for later social developments. Although some foragers may have retained their lifeways in some areas, others evidently chose to adopt newly available domesticated resources for their own ends, and others may have been involved in long-distance exchange systems that brought exotic cultigens to the valley. Whether located in the Q. del Batán, Q. Talambo, and Q. Cupisnique, or along the Pacific coast, foragers apparently had the ability to maintain themselves as independent and co-dependent players in a wide-ranging and diverse network of socioeconomic interaction. As modern-day forager

groups in Africa (Barham and Mitchell 2008: 433–441), Asia (Lane 2004; Reddy 1988), and South America (Maybury-Lewis 1999) have shown, they survive in close proximity to farmers and/or pastoralists and still retain a significant degree of autonomy from their neighbors.

Last, in returning to Binford's (2001) notion of complexity being partially related to demographic "packing thresholds" in particular environments, which results in experimentation with a wide variety of organizational and technological solutions (e.g., food production and intensification) to offset resource stress caused by population pressure, we have no hard evidence of population or resource pressure on people during any phase of the Preceramic period. However, there is evidence of deliberate or artificial social packing in an environment of resource richness and thus of the lowest economic stress and risk: this was the dry forest of the Nanchoc basin. This resulted in the development of plant cultivation and creative bridgehead communities during the Las Pircas and Tierra Blanca phases. People during all phases had choices. If there was resource stress, population pressure, or social tension, people could have moved to distant quebradas where water, food, and other resources were available. But in the Nanchoc basin they did not move if they were under any of these or other stresses. The absence or near absence of archaeological sites in several quebradas indicate that people chose to live closely together whatever problems they might have had. Such a finding supports the argument that landscape composition and social choices, rather than resource depression and/or direct negative impact of climate change, were the primary causes of the adoption of food crops and community development in the study area.

WIDENING THE SCOPE OF INTERACTION

In looking at the long Preceramic period on the north coast of Peru and its contributions to later Andean society, we see more and more that social relations do not conform until the late Preceramic period or early Formative period (ca. 4500–3500 BP) to the elite and nonelite dichotomy found in so many archaeological discussions of emergent social complexity in other parts of the world (e.g., Arnold 1996a,b; Bogucki 2009; Chapman 2003: DeBlasis et al. 1998; Iriarte et al. 2004; Lima and Mazz 2000; Richerson et al. 2001; Smith 2001). We believe that north coast people and Central Andeans of the middle and late Preceramic periods were focused more on building a sense of social collectivity through communal projects and, to a lesser extent, ritual practices, as evidenced at the Nanchoc sites. Equally significant was the construction of monuments and agricultural features,

and the development of inter-community strategies rather than the strategic pursuit of power or prestige through the accumulation of wealth goods (e.g., Burger 1992; Dillehay et al. 2004). Such shared, distributed, public power systems were probably fueled more by socio-ideational than material wealth. We presently cannot identify any social loci, schism, resistance, and agency or institutional strategies in the hard archaeological evidence that may have constrained and/or counterbalanced the development of elite individuals and the pursuit of power through the accumulation of wealth goods. Our research does not show that status-driven "Big Men" created an ambience of accumulative wealth from agricultural surplus, which enhanced the power of individuals and the group overall (Hayden 1995). This level of social development occurred much later during the late Initial Period and Early Horizon (~3500–2800 BP). However, at some point in the late Preceramic period or the subsequent early Initial Period (~4500–3500 BP), a critical moment was reached when more emphasis was given to large-scale ceremonial activity, perhaps wealth goods, and individual leadership, as perhaps suggested at Limoncarro, Montegrande, San Luis, and other early Formative sites in the study area. At present, we do not understand this shift.

To whatever extent the processes recognized here were typical of other places in the Andes (e.g., late Las Vegas, Alto Salaverry, Caral, Asana), the sequence of stages conducting it is rich in implications for the emergence of early household community development, spatially separate public projects, food production, and social complexity. This sequence began with the production of squash by dispersed proto-households (late Paiján subphase), household-based technologies, crop production, and ritual (Las Pircas phase), then proceeding at the public Nanchoc mounds, first with ritual (late Las Pircas phase) and then through ritualized technical production of lime and multiple household food production (Tierra Blanca phase). This suggests that in one area of the Central Andes communal-based technical, social, and ritual changes developed before political changes. It also appears that in the prelude to the rise of the later ceremonial places like Purulén, San Luis, Tembladera, and Cupisnique in the study area, there were communities like Nanchoc with relatively advanced stages of ritual and technical maturation and relations of local communal labor, which had developed independently of centralized leadership and a village lifeway.

So far as any sort of chronological associations can be made, it is our view that the foundational seeds for the later rise of the large-scale inter-community ceremonialism evidenced at local and regional ceremonial centers during the late Preceramic period and Initial Period were planted during

the preceding Las Pircas and Tierra Blanca phases. More specifically, the feasting hypothesized for the San Luis and Macauco sites in the middle Zaña Valley and the La Toma and Uscundal sites in the upper Zaña Valley (Dillehay 2004) during the latter Initial Period (∼ 3500 BP) required the levying of more produce from more affiliated communities, cooperation in the management of other multiple groups, and more complex processes of decision and policy execution than in the earlier phases. Thus, step by step, a qualitatively new and perhaps semi-centralized form of group or dual communal authority associated with larger settlements and centers came into being during the late Initial Period in the study area (i.e., the San Luis site; see Dillehay 2004). Such an authority must have promoted the production of exchange goods and the extraction and distribution of a surplus; set in this context, exchange and a more centralized political authority would eventually have evolved together with public rituals and the use of new technologies. The stage was then set for the type of sociocultural complexity and greater levels of inter-community interaction witnessed during the following terminal Initial Period and Early Horizon (∼3500–2500 BP).

SMALL THOUGHTS, BIG CHANGES

Most models for the development of sedentism, food production, and early complexity after the Pleistocene period invoke climatic and environmental change to explain cultural changes. In our study area, certainly favorable or unfavorable climatic conditions were variables influencing human populations throughout time, especially along the Pacific shoreline and in the coastal plains and lower elevated, more arid habitats. Wetter and milder climatic conditions around 10800 BP must have been favorable to people of the late Paiján phase who began to cultivate squash and practice a mixed foraging and gardening economy. Based on our data, we believe that the Paiján people established the principal social, economic, and demographic foundations for the subsequent, more complex cultures (cf. Moseley 1992: 88). There is evidence for some increased aridity during the middle Holocene period, but it had less impact on the higher elevated, ecotonal forested habitats of the Nanchoc basin in the upper Zaña Valley than on the lower regions. The rich, dry forest in this area experienced the major developments of food production and social complexity and did so during the height of the so-called arid hypsithermal period. The Las Pircas and Tierra Blanca populations residing in this forested ecotonal setting of the Nanchoc basin had access to highly variable and rich resource zones,

including the thorn and *algarrobo* forests of the Q. del Batán drainage, the coastal plains to the west, and the dry forests and humid forests and higher grasslands to the east. The location of people in these areas and in lower elevated zones where permanent water sources existed (i.e., Q. del Batán, Q. Talambo, and Q. Cupisnique) permitted the sustained presence of populations. Agriculture had its local beginnings in the seasonally dry forest of the Nanchoc basin. The water feeding crops in this area was drawn from the humid montane forest and the highlands to the east which rose between 1,500 and 2,500 m in elevation.

Although changing environments and climates had their impact on human populations, we do not see demographic or social stress caused by population overcrowding and pressure on food resources anywhere in the study area. As noted previously, if overcrowding occurred, people could have moved to a number of uncrowded to nearly empty quebradas and other habitats within a distance of a few kilometers. We do not see the growth of large, dense populations until the end of the Formative period (2,500 years ago), and this happened in only a few locales in the study area. This does not imply, however, that overcrowding did not result from people deliberately aggregating in certain places, such as the Nanchoc basin. But even here, if there was population and resource pressure placed on people during the late Las Pircas and Tierra Blanca phases, people had options other than out-migration to resolve the problem – for instance, the intensification of food production through irrigation farming.

It is thus difficult to apply a single paradigm to explain the archaeological variability observed across time and space in the study area. In some ways, an environmental model best fits issues of site frequencies and duration of occupation in the more extreme arid (e.g., coastal) and humid (upper forest) zones, especially during the earlier periods of widespread foraging. But it is a combination of social and natural conditions that best fits other places where settlement aggregation occurred, such as the tropical dry forest. Around 5,000 years ago, the study area experienced a major settlement shift toward larger expanses of fertile agricultural lands farther down valley toward the coast. But even this shift is associated with social and cultural modifications that allowed for this development.

These modifications involved long-term demographic changes and short-term social relations within circumscribed communities, especially those in the Nanchoc basin. The public nature of activities at the Cementerio de Nanchoc site and the irrigation canals may have encouraged a collection of households to merge with other nearby residential groups. Yet, an increase in scale and density in Tierra Blanca sites also may have

challenged the existing social and labor organization. Shifting patterns in ritual and mortuary practices may reflect these changes, with cannibalism possibly a result of social conflict between neighboring groups. However, when such practices are conducted more frequently and more successfully, the foundations for social cohesion are strengthened or perhaps weakened. The later agglutination of households at sites like CA-09–71 and CA-09–77 may reflect such kinds of social forces at work. With a strengthening of the communal and ideological structure upon the aggregated community in the Nanchoc basin, small groups were more able to maintain local solidarity and to achieve some remarkable developments. In comparison to other populations in the study area, people of the Nanchoc basin created a bridgehead community that merged an ideology of collective ritual and labor with the social intensification of more permanent and closely spaced living conditions.

Margaret Mead is often quoted as saying: "Never doubt that a small group of thoughtful, committed citizens can change the world. Indeed, it's the only thing that ever has" (Wikiquote 2009). Although the population sizes of the Preceramic period were small in comparison to those of the later Formative Period and to today's world, the essence of this statement is still applicable to the time period under study here. We should keep in mind two challenges, other than climatic and social changes, that community members or organizers likely faced during this period: new technologies and old cultural traditions. In the first case, certain individuals were probably empowered by technological or "knowledge status." Some decision making regarding the adoption, invention, and use of certain technologies (e.g., plants, canals, tools) must have been made by technocratic- or expert-centered individuals and households. Knowledge status was likely more subtle and elusive than ideological, ritual, or material statuses, but this does not mean it was any less effective. Given the scale and complexity of developments taking place in the study area through time, it is our guess that during the El Palto and perhaps the early Las Pircas phases, people consensually mobilized and coordinated their tasks and experiences in contrast to organizing them in the subsequent late Las Pircas and Tierra Blanca phases. Earlier mobilizers and coordinators likely dealt with predetermined task slots, as defined in Binford's model of task-oriented residential sites. Later organizers probably dealt with building a more settled social life and with establishing roots in logistically permanent places such as the Nanchoc basin. The organizers of Nanchoc built a public culture and a public community such as that seen at the Cementerio de Nanchoc site. The difference between a mobilizing/coordinating and an

organizing culture is the public building process associated with the latter. That is, late Las Pircas and Tierra Blanca peoples built the infrastructure for public places and public institutions at the Cementerio de Nanchoc mound site and at the irrigation canal and associated agricultural fields. This was first done through organizing *outside* exchange systems and building the first layers at the mound site during the late Las Pircas phase and then turning *inside* and privatizing during the Tierra Blanca phase when exotics disappeared.

The second challenge is culture – more specifically, the ways in which the predominant and traditional forager ways of doing things were followed or changed. Localized social and demographic movements in the dry forest of the Nanchoc basin during the late Las Pircas and Tierra Blanca phases could not have been brought into existence from scratch. They must have emerged from the coalescence, interconnections, and common sense of social momentum coming from diverse trends and directions, as evidenced by the exotic curiosities (including cultigens), but also from a bridgehead or seed-bed community, which in this case was those aggregated households living in the Nanchoc area. What makes the Nanchoc basin *evolve* rather than *revolve* during the Las Pircas and Tierra Blanca phases? All evidence suggests that forager groups living in the Q. del Batán, Q. Talambo, Q. Cupisnique, and other areas were constantly revolving through various cycles and levels of foraging and then perhaps horticulture and then back again to foraging. This is particularly well evidenced at the Cerro Guitarra site, which likely was part of a local tradition that continued to rely on a mixed economy as late as 4000–3500 BP. The revolving proliferation of foragers during all phases was not a dramatic transition into a new transformation but simply a continuation of old and new practices that had been going on for several millennia. However, the Nanchoc area points to a larger, more evolved, and transformative shift to other kinds of technological, social, and demographic developments.

The multiple types of co-existing forager and farmer communities and organizations discussed throughout this book do not simply represent an analytical construct, but an inference drawn from the archaeological record. We are not implying a form of structuralism here whereby all parts of the socioeconomic system worked together with a sufficient degree of harmony or internal consistency (*sensu* Radcliffe-Brown 1954). The data suggest multiple versions of social and economic organization, none of which during the Preceramic period dominated enough to eliminate or influence the others. Curiously, we presuppose that these organizations were guides and agents for their own practices and actions. What happened

when people chose between different organizations? And if we focus not on outcome but on agency, specifically the strategies that people used in order to prevail, then it links techniques with the contexts – organizations and motives – that give the techniques substance and meaning. This procedure alters the concept of organization: it is no longer seen as a social or economic organization but as a resource used by a small group of people to "change the world."

APPENDIX ONE

Radiocarbon Dates for All Preceramic Phases and Subphases†

Label no.	Site/Unit	Conventional radiocarbon in BP years	2∑-calibrated age range BP*	Dated material
El Palto Phase (13800–9800 BP)*				
Beta 20887	CA-09–89	11650 ± 180	13859–13178*	Midden charcoal
AA57961	JE-790	11220 ± 700	14975–11207*	Midden charcoal
AA57942	JE-1002	11014 ± 64	13073–12860*	Midden charcoal
Beta 185074	JE-996	10650 ± 50	12822–12413*	Midden charcoal
AA57948	JE-996	10353 ± 58	12571–11986	Midden charcoal
AA57946	JE-996	10230 ± 59	12230–11653*	Midden charcoal
AA57947	JE-996	10113 ± 76	12037–11360*	Midden charcoal
Early Paiján Subphase (13000–11200 BP)*				
GIF 9405#	PV-22–14	10640 ± 260	13099–11708	Midden charcoal
Beta 154123	PV-1996–1	10520 ± 60	12769–12237*	Midden charcoal
GIF 5160#	PV-22–14	10380 ± 170	12796–11616	Midden charcoal
Beta 154141	CA-09–55-2	10360 ± 100	12648–11825*	Midden charcoal
Beta 154128	PV-19–57-2	10260 ± 90	12552–11614*	Hearth charcoal
GIF 3781#	PV-22–13	10200 ± 180	12598–11261	Midden charcoal
Late Paiján Subphase (11200–9800 BP)*				
AA57950	JE-439	10056 ± 67	11962–11309*	Hearth charcoal
AA57963	JE-431	9983 ± 93	11951–11221*	Midden charcoal
Beta 154099	PV-19–122-1	9980 ± 80	11801–11231*	Midden charcoal
Beta 12384	CA-09–27	9870 ± 120	11820–10815*	Midden charcoal
AA57949	JE-439	9851 ± 58	11587–11171	Midden charcoal
GIF 4161#	PV-22–13	9810 ± 180	11961–10693	Midden charcoal
GIF 4912#	Ascope 5	9670 ± 170	10995–10441	Midden charcoal
GIF 5162#	PV-22–14	9600 ± 170	10995–10305	Midden charcoal
Beta 185076	JE-790	9530 ± 70	10995–10524*	Midden charcoal
Beta 154124	PV-19–97-8	9520 ± 130	10995–10304*	Midden charcoal
GIF 4914#	PV-22–13	9490 ± 170	10995–10295	Charcoal
GIF 5161#	PV-22–14	9360 ± 170	10995–10191	Charcoal

(continued)

(*continued*)

Label no.	Site/Unit	Conventional radiocarbon in BP years	$2\sum$-calibrated age range BP*	Dated material
AA 57958	JE-790	9334 ± 50	10643–10267*	Midden charcoal
GIF 4915#	PV-22–13	9300 ± 170	10995–9933	Charcoal
Beta 79512	CA-09–77	9240 ± 50	10403–10163*	Charred squash seed
AA 57964	JE-431	9041 ± 48	10241–9918*	Hearth charcoal
AA 57955	JE-431	9032 ± 50	10236–9916*	Midden charcoal
AA 57956	JE-431	8983 ± 65	10229–9780*	Midden charcoal
*Las Pircas Phase (9800–7800 BP)**				
AA 57943	JE-1002	8854 ± 62	10155–9599*	Hearth charcoal
AA 57969	JE-937	8751 ± 47	9887–9541*	Midden charcoal
GIF 5159#	PV-22–14	8730 ± 160	10195–9420*	Charcoal
Beta 154126	PV-19–101-11	8470 ± 60	9540–9420*	Midden charcoal
Beta 206431	JE-772	8420 ± 40	9487–9271*	Midden charcoal
Beta 33526	CA-09–27	8410 ± 140	9580–8996*	Midden charcoal
Beta 154125	PV-19–100-10	8270 ± 60	9450–9040*	Midden charcoal
Beta 227211	CA-09–77	8360 ± 90	9482–9032*	Human jawbone
GIF 4162#	PV-22–27	8260 ± 160	9516–8658	Charcoal
Beta 33524	CA-09–27	8260 ± 130	9484–8772*	Midden charcoal
Beta 33523	CA-09–27	8210 ± 180	9481–8606*	Midden charcoal
Beta 30781	CA-09–27	8080 ± 70	9111–8636*	Midden charcoal
Beta 12385	CA-09–27-5	7950 ± 180	9256–8378*	Midden charcoal
Beta 12384	CA-09–27	7920 ± 120	9002–8427*	Hearth charcoal
Beta 33525	CA-09–27	7850 ± 140	9005–8370*	Midden charcoal
Beta 219588	CA-09–77	7840 ± 40	8640–8435*	Charred peanut
UCR-2371	CA-09–04-A	7720 ± 100	8691–8203*	Hearth charcoal
Beta 30779	CA-09–27-5	7690 ± 70	8587–8330*	Hearth charcoal
Beta 219589	CA-09–52	7660 ± 40	8535–8342*	Charred squash seed
Beta 30778	CA-09–27-5	7630 ± 80	8541–8199*	Hearth charcoal
Beta 182962	CA-09–04	7520 ± 40	8373–8189*	Organic sediment-use floor
Beta 15708	CA-09–04-B	7190 ± 130	8274–7677*	Hearth charcoal
Beta 226458	CA-09–77	7120 ± 50	8000–7763*	Coca leaf
Beta-226462	CA-09–71	7080 ± 40	7953–7746*	Coca leaf
*Tierra Blanca Phase (7800–5000 BP)**				
Beta 154128	CA-09–04-B	6970 ± 90	7933–7595*	Hearth charcoal
Beta 3825	CA-09–04-B	6850 ± 80	7824–7500*	Hearth charcoal
Beta 154128	PV-21–458-13	6790 ± 90	7746–7433*	Midden wood
Beta 4562	CA-09–04-B	6730 ± 110	7739–7327*	Hearth charcoal
Beta 34332	QSN-1	6705 ± 75	7656–7426*	Charcoal in canal base
AA 57952	JE-901	6670 ± 230	7935–7006*	Midden charcoal
Beta 60887	CA-09–71	6670 ± 60	7592–7422*	Hearth charcoal
Beta-40626	CA-09–04	6650 ± 80	7613–7324*	Hearth charcoal
Beta 39457	PV-19–60	6400 ± 60	7421–7163*	Midden charcoal
Beta 40633	PV-19–23	6240 ± 100	7307–6797*	Midden charcoal
Beta 191662	CA-09–67	6140 ± 40	7156–6797*	Charcoal canal
Beta 60887	CA-09–71	6140 ± 40	7156–6797*	Midden charcoal
GIF 3565#	PV-22–12	5940 ± 140	7156–6353	Charcoal
Beta 4243	PV-10–13, Macauco 1	5910 ±390	7555–5794*	Hearth charcoal

Label no.	Site/Unit	Conventional radiocarbon in BP years	2∑-calibrated age range BP*	Dated material
Beta 176541	CA-09–04	5650 ± 60	6525–6279*	Hearth charcoal
Beta 181279	CA-09–71	5460 ± 60	6278–5948*	Cotton boll
Beta 154127	QSN-1	5380 ± 80	6273–5936*	Charcoal in canal base
AA 57960	JE-393	4584 ± 36	5313–5045*	Midden charcoal
Beta 182966	QSN-1	4390 ± 40	5038–4833*	Charcoal in canal base
Terminal Preceramic and Aceramic (5000–4000 BP)*				
Beta 4563	CA-10–19	4200 ± 70	4844–4445*	Midden charcoal
Beta 109092	JE-242	4190 ± 40	4823–4529*	Midden charcoal
Beta 36783	CA-09–77	3695 ± 70	4154–3723*	Human bone
AA 57965	JE-971	3690 ± 440	5271–2865*	Midden charcoal
Beta 36782	CA-09–50-79	3680 ± 60	4145–3725*	Hearth charcoal
Beta 79416	CA-09–04	3650 ± 60	4084–3718*	Midden charcoal
Beta 4563	CA-09–04	3520 ± 480	5044–2496*	Midden charcoal

All dates were calibrated using Stuiver and Reimer (1993; version 5.0.2).

† All dates mentioned in the texts are in calibrated years BP.

* Calibrated with Southern Hemisphere Calibration curve: shcal04.14.

Radiocarbon dates from Quebrada Cupisnique (Chauchat et al. 2006).

APPENDIX TWO

Dry Forest Biomes of the Coastal Valleys and Lower Western Slopes in Northwestern Peru

Patricia J. Netherly

INTRODUCTION

This account is based on the dry forest vegetation present today in the valleys of the study region. The distribution of biomes in the very recent past is shown in Figure 3.4 (Chapter 3). What is missing for an assessment of the dry forest resources present before the implementation of a widespread regime of irrigated agriculture some 6,000 years ago is an assessment of the trees and herbaceous vegetation, together with the micro-climates they engendered, within a particular biome. Most botanical descriptions of seasonal forest vegetation have concentrated on the larger trees, neglecting shrubs, forbs, and grasses. A detailed knowledge of all potential plant resources present in the environment is of particular importance for archaeologists studying early hunting and foraging populations and populations making the transition from dependence on game and gathered foods to dependence on cultivated crops.

In the absence of proxy evidence from pollen and phytoliths, the reconstruction of past biomes is dependent on existing plant communities, which are frequently found today in partial form, displaced by cultivation to the margins of the valleys. In contrast, the wetland associations – the back swamps of the littoral, the estuary associations, the riverine biome, and that of the freshwater ponds of the lower valley – may be depauperate but are in approximately the same locations. The arid inter-valley biome, largely populated by *Tillandsia* and *Capparis* (zapote), is another biome that has not moved.

In other cases the anthropogenic disruptions have been so great that it is necessary to look farther afield to find relatively undisturbed associations from which the original biome can be inferred. This is true for the thorn scrub biome of the lower valleys, the *algarrobo* forests or *algarrobales*, and

for the thorn thicket and deciduous forest biomes of the middle and upper valleys. After over 12,000 years of human intervention by burning and cultivation, reconstructing these associations is difficult (Bush et al. 2005; Hansen et al. 2003; Weberbauer 1936; Weng et al. 2006). In particular, the former riverine associations have largely disappeared as have those of areas of high water table that have been replaced by cultivation (Sagástegui 1973).

In assessing the extent of such associations in the early to mid-Holocene, two factors must be considered: first, the increase in desertification through the systematic cutting and grazing of areas dedicated to irrigated agriculture; and second, systemic variations in the precipitation regime itself. In addition, commercially valuable trees are missing from several of these biomes: areas of high water table, the thorn thicket, the deciduous forest, and the evergreen seasonal forest. A clue to the stability of the aridity of the littoral and valley margin environments in the past may be found in the nature of the metabolic adaptations of plants, such as *Tillandsia* and cactus, growing there (see Appendix 3).

Recent research in Piura has supplemented the taxonomic study of Sagástegui for the Chicama Valley and the brief comments of Weberbauer (1936) on dry forest species of potential interest for human populations. Two of these studies focus on the forest where today *algarrobo* is dominant at two sites between 5 degrees and 6 degrees South Latitude rather than on the more general category of dry forest (Cárdenas et al. 2001; Gushiken et al. 2001). A third study by Rodriguez and his associates focused on the patterns of growth of different trees, still found today in Piura but widely dispersed because of exploitation, which underscores their different adaptations to aridity (Rodriguez et al. 1993). The environments in which these trees are found are sufficiently like those of the study area to permit comparison.

Wetland Associations

Wetlands are found in three geomorphological contexts on the coastal plains of the valleys of the study region: the back swamps, long depressions behind the beach ridges characterized by a high water table with salt or brackish water; the low-lying areas around the estuaries of the rivers, which may include abandoned river channels and lagoons; and depressions farther inland that approach the freshwater water table. These ponds or *lagunas* can support a hydrophytic vegetation away from the river and inland from

the littoral and may be surrounded by much more xeric associations. In this, their importance is similar to that of the permanent springs found on the lower western slopes of the cordillera (see Figure 3.2).

Back swamp wetlands are found between valleys as well as within them. The back swamp formations are supported by the marine and freshwater phreatic levels and are usually brackish to saline depending on their distance from the sea. Later irrigation agriculture may have increased the freshwater component of these wetlands. A number of reeds, among them totora, *Scirpus californicus*, which tolerates brackish water, were important to pre-agricultural populations not only as a source of construction material but also as food, since the bulb is edible. These natural stands could be harvested repeatedly. During periods of exceptionally high surf, seawater will wash over the beach ridges and deposit saltwater and fish in the back swamp wetlands. Like the reeds, fish could be taken easily from the shallow waters of the swamp (see Figure 3.10).

The river estuaries frequently support extensive wetlands where the rivers meet the sea. Because they are tidal, the water is brackish, varying in salinity with the seasonal discharge of the river. Away from the river, the current is slow and waters are shallow (see Figure 3.11) Where the water is not too brackish, various species of *Cyperus* as well as *Typha angustifolia* (*enea*) can be found in association with totora. *Junco* sp. may also be present. Like totora, enea also produces an edible bulb as does *Cypereus rotundus* (*coquito de chancho*). There are several marine fish species that are regularly found in the brackish waters of the estuary and some even tolerate fresh water and migrate some tens of kilometers upriver. Prized among these fish is mullet, *Mugil cephalus* (*liza*). These and other brackish water–tolerant species may enter the estuary channels as fingerlings, growing to maturity in the backwater channels. Rays are another species that enters the brackish waters of the estuary (Netherly 1986). Many of the same species found in the back swamps behind the beaches are also found here, particularly during periods of low river discharge. When river discharge is high, however, it dominates the river mouth. In sum, the salt grass associations merging gradually to communities of sweet grass, totora, and other reeds, and the mingling of riverine and marine species of fish characteristic of river estuaries make this a particularly rich resource zone.

In the lower valleys today the predominant riverine vegetation is made up of canebrakes, shrubs, and small trees. The original canebrakes were composed of *Gynerium saggitatum* (*caña brava*) and *Phragmatis comunis* (*carrizo*), used today for baskets and matting. Some species of shrubs appear on the

landward side of the estuarine wetlands. One of these is *Tessaria integrifolia* (*pájaro bobo*), which can reach the size of a sapling. Two others, *Baccharis glutinosa* and *B. lanceolata* (*chilco "hembra"* and *chilco "macho"*) approach the littoral. Both varieties of chilco form dense thickets, and of the two, *B. lutinosa* is the more salt tolerant, extending farther away from the riverine environment. Another thicket-forming shrub is *Plucboya chingoyo* (*toñuz*). A fruit-bearing shrub, *Rapanea manglillo* (*manglillo* or *lúcuma del monte*) has a range extending from sea level to 2,400 m (Sagástegui 1973). *Molle*, (*Schinus molle*), a small tree, can be found at some distance from the river beginning at an altitude of about 300 m (A. Sagástegui, personal communication, 1972).

Except for the tidal zone in the estuaries, the influence of the sea on the riverine ecozone is negligible. Along the banks of the river and on the floodplain, influenced by the high riverine water table, there is a characteristic vegetation community that today is greatly degraded through human action and can be reconstructed from the less disturbed stretches present in some valleys. In the past there were large trees that are properly characteristic of more mesic biomes, which extended these associations into the dry forest. Willow (*Salix chilensis*) is the most important tree found along the river margins today. It would have been present in the past but may not have been predominant. The very early sites at Carrizal in the lower Zaña Valley were likely to have been riverine in orientation since the littoral would have been farther to the west and the water less likely to be brackish as it is in the estuary. Many estuarine fish species move upriver and can tolerate freshwater, thus reinforcing the potential productivity at Carrizal. Plant resources and avifauna would also have been important. Upstream, the rivers are too shallow and the current too swift, except near the estuary, to make them a major resource zone for fishing. However, the freshwater crayfish, *Astacus pluviatitus*, was harvested and dried in later times and may have been a resource much earlier (Rossen 1991).

The third wetland type to be considered are the ponds (*lagunas* or *puquios*) found in depressions in the lower valleys where the water table lies close to or at the surface. Some are fairly close to the sea, others farther inland. All are freshwater ponds or seeps. The plant resources are similar in type to those of the estuarine wetlands but may also have shared species with the riverine biome. Such ponds could support more mesic trees and shrubs, characteristic of the evergreen dry forest or even wet forest biomes, thus bringing the resources of more distant habitats onto the coastal plain and increasing the micro-environments available to peoples living near them. Without a natural link to the river, fish could enter these lagoons

only through sheet flooding from the river during times when the river overtopped its banks. This may not have been an annual occurrence. Thus, in the early millennia of the Preceramic period before deliberate manipulation by human intervention, these lagoons could have been an important resource zone for early foragers and horticulturalists.

Characteristic Species of the Principal Dry Forest Associations

Cacti, another dry forest association, can form dense stands. They are found on the coast as well as on the western slopes of the cordillera, where they appear as a component of dense thorn scrub and thorn thicket associations. The most important species are *Neoraimondia macrostibas* (*gigantón* or *porgón*), a columnar cactus whose wood can be used in construction (Sagástegui 1973). The fruits of several species can be eaten. Wild life, particularly deer and peccary, can sustain themselves in dry forest by knocking over cacti and scraping away the spiny cortex with their hooves to get at the succulent inner pulp (Netherly, personal observation).

The principal species of the dry forest association in the valleys include the following shrublike forms: *Cryptocarpus pyriformis* (*chope*); *Capparis angulata* (*zapote*), the leaves of which provide browse, while the gum secreted by the stem and the fruit were used aboriginally; *C. ovalifolia* (*guayabito de gentil*), a large bush in favorable circumstances with an edible, berrylike fruit; *Parkinsonia aculeata* (*uña de gato*) a very spiny bush; Palo verde (*Cercidium praecox*), capable of growing in extremely dry environments and even when totally covered by sand with only the flowers showing above the surface; *Acacia macracantha* (*espino* or *huarango*), an erect thorny shrub; *A. huarango* (also called *espino* or *huarango*), a prostrate thorny shrub; and *Scuttia spicata* (*pial*), a large spiny shrub. These shrubs may be secondary members of communities consisting of *Prosopis chilensis* (*P. juliflora*), *algarrobo* or *faique*. Faique refers to *Prosopis* sp. in Lambayeque, but in Viru it refers to *A. macracantha*. *Algarrobo* wood, gum, and fruit (pods and seed) are all utilized. Formerly, extensive areas of the North Coast were covered with *algarrobo* forests (Sagástegui 1973). The more xerophytic algarrobo and *espino* can be also be found at the margins of the valleys (see Figure 3.9).

In 1975, dense, impenetrable thickets of *pial*, *espino*, and *guayabito de gentil*, with some *algarrobo* were observed in areas of relict thorn scrub in the lower Viru Valley. Inland associations on moderately saline soil consisted of *algarrobo*, *espino*, *pial*, and *B. glutinosa* (*chilco hembra*). This association, called *monte*, formed a solid spiny wall some four meters high. On more saline soil, in an area of degraded *monte* (Monte de Santa Cecilia), *algarrobo*,

espino (*A. macracantha* and *A. huarango*), *chilco hembra*, *guayabito de gentil*, and *uña de gato* were present in isolated clumps interspersed with salt grass and junco reeds growing in standing water and on dry ground. All these plants were maintained by the relatively high water table. The traditional way of clearing this association is to burn it and then grub out the roots with a digging stick; this would not have been technically beyond early and middle Preceramic populations.

There do not appear to be altitudinal constraints on the dry forest association below 1,000 m. The environmental constraint is moisture. In some cases the same species can survive extreme conditions of aridity near the littoral and flourish farther upvalley. *Algarrobo* (*Prosopis* sp.) survives by means of an extremely long taproot that can reach deep underground aquifers, and *zapote* (*Capparis* sp.), which grows continuously, must obtain moisture from the atmosphere and have mechanisms in place to conserve moisture in extreme conditions. Many of the most prominent plants of the most arid zones – the cacti, some *Tillandsia*, some of the succulents, and about half the grasses – use the Crassulacean acid metabolism (CAM) route of photosynthesis, which is an adaptation to environments of extreme aridity that greatly enhances the plant's efficiency obtaining and conserving water (Raven et al. 2005). Almost all of the plants with CAM photosynthesis are adapted to extremely arid conditions or conditions of extreme seasonality. Their presence in the dry forests of the North Coast past and present is entirely predictable and confirms arid conditions in the past (see Appendix 3). Thus, the distribution of these plants today can provide clues to past biogeographic conditions.

The Piura *Algarrobo* Forests

More information about the dry forest biomes can be gained by examining the data from the *algarrobo* forests of Piura. One study focused on tree growth at different locations in Piura (Rodríguez et al. 1993). Two more recent studies at two sites, one more arid than the other but both located in algarrobo forest, provide useful information about species diversity and productivity during and after ENSO (El Niño/Southern Oscillation) events (Cárdenas et al. 2001; Gushiken et al. 2001). These sites are at about 5 degrees South Latitude. The study areas in the Nanchoc basin and in the Jequetepeque Valley lie at about 7 degrees South Latitude. Today, the sites studied by Gushiken and Cárdenas in Piura differ in the amount of precipitation they receive annually. They experience El Niño

rains about two or three times a decade – these are not necessarily major events. On the off years there is very little rainfall, particularly at the more arid forest/savanna site. It is suggested that the late Pleistocene and early Holocene rainfall patterns in the Nanchoc basin and the study areas in the Jequetepeque Valley may have been similar but with more seasonal rainfall and less dependable ENSO precipitation.

Table A2.1 gives the inventory for plant species generally found in areas of dense *algarrobo* forest at an altitude of about 500 m, which may be more comparable to the Nanchoc area (Cárdenas et al. 2001, Tables 1,2; Gushiken et al. 2001, Table 1). This list is particularly valuable because it includes the herbaceous vegetation and grasses, which may be evident only after the infrequent rains, in addition to the more permanent trees and shrubs. Although this area has suffered desertification through overgrazing and the cutting of trees with commercial value, a number of species remain in addition to *algarrobo* (*Prosopis pallida*) that would have been of interest to foragers. Among them are *Capparis* sp., zapote; *Cyprus* sp., reed; *Ipomea* sp.; *Cucumis dipsaceuis* and *Luffa operculata*, both saboniferous; *Lycopersicum pimpinellifolium*, *tomatillo de culebra*; *Momordica charantia*, *papayilla*; and *Physalis angulata*, *capullí cimarrón*. Two other species of possible interest for foragers noted by Weberbauer for much the same area at the beginning of the twentieth century can be added to this list (1936). Both plants produce tubers. They are *yuca de caballo* (*Proboscidea althaeifolia*), the desert unicorn plant, and *yuca del monte* (*Apodanthera biflora*), a curcurbit. The comparative poverty of shrubs and trees other than *algarrobo* should be noted as a possible result of overgrazing.

The study by Cárdenas and her co-authors charts the increase in productivity after the major ENSO event in 1997–1998. This study was carried out in an area of arid open savanna/*algarrobo* forest as well as in the more humid area in San Lorenzo studied by Gushiken. Both areas demonstrate marked seasonality with rainfall during only three months of the year and some years without any significant precipitation. The data from the productivity study are of great interest for understanding the effect of more frequent rainfall on vegetation in the Nanchoc-Jequetepeque study area under the kind of precipitation regime we have suggested for the late Pleistocene/early Holocene time period. Tables A2.2 and A2.3 trace the changes in the vegetation from vegetative growth, to flowering, to the growth of fruit and the setting of seed over a six-month period from January to June after the onset of ENSO rains. Table A2.2 shows the reduced species list for the savanna *algarrobo* forest while Table A2.3 shows

Table A2.1. Contemporary Inventory of Plants Found in the *Algarrobo* Forests of Piura

Species	Family	Common name
Acacia macracantha Humb. & Bompl.	Fabaceae	Faique
Acacia huarango	Fabaceae	Aromo [qv.huarango]
Acanthospermum hispidum DC	Asteraceae	Abrojo
Anthephora hermaphrodita (L.) Kuntze	Poaceae	Yuyo
Bidens pilosa L.	Asteraceae	Amor seco
Boerhavia sp.	Nyctaginaceae	Pega-pega
Bouganvillea sp.	Nyctaginaceae	Bouganvilia
Capparis scabrida H.B.K.	Capparidaceae	Sapote
Capparis crotonoides H.B.K.	Capparidaceae	Satuyo
Capparis avivennifolia H.B.K.	Capparidaceae	Bichayo
Cenchrus pilosus H.B.K.	Poaceae	Falso Cadillo
Cercidium praecox (R&P) Harms	Fabaceae	Palo verde
Chloris virgata Swartz	Poaceae	Crespillo
Cordia lutea Lam.	Boraginaceae	Overal
Crotolarria mucronata Desv.	Fabaceae	Choclillo
Cucumis dipsaceus Ehrenb ex Spach	Cucurbitaceae	Jabonillo
Cyperus sp.		Cyperaceae
Encelia canescens	Asteraceae	Charamusco
Eragrostis cilianensis (Alioni) Lutati ex Janchen	Poaceae	Crespillo
Eragrostis ciliaris (L.) R. Brown	Poacea	
Chamaesyce hipericifolia L.	Euphorbiaceae	
Heliotropo sp.	Boraginaceae	
Indigofera microcarpa Desv. Journ	Fabaceae	Alfalfilla
Ipomoea crassifolia Cav.	Convolvolaceae	Bejuco de venado
Ipomoea piurensis O'Donell	Convolvolaceae	Corre y vuela
Iresine sp.	Amaranthaceae	Hierba blanca
Jacqumontia unilateralis (Roemer & Schultes) O'Donell	Convolvolaceae	Campanilla
Lantana sp.	Verbenaceae	Mosqueta
Ludwigia octovalvis	Onagraceae	
Luffa operculata (L.) Cogniaux	Cucurbitaceae	Jabonillo
Lycopersicum pimpinellifolium (l.) Miller	Solanaceae	Tomatillo de culebra
Merremia aegyptia (L.) Urban	Convolvolaceae	
Momordica charantia L.	Cucurbitaceae	Papayilla
Monnina sp.	Polygalaceae	
Nerium oleander L.	Apocynaceae	Laurel rosa
Parkinsonia aculeata L.	Caesalpinaceae	Palo verde
Physalis angulata L.	Solanaceae	Capullí cimarrón
Plumbago sp.	Plumbaginaceae	
Prosopis pallida (Humboldt & Bompland ex Wildenow)	H.B.K. Fabaceae	Algarrobo
Solanum americanum Mill.	Solanaceae	Hierba mora
Struthanthus sp.	Loranthaceae	Piña
Tephrosia cinerea L.	Fabaceae	
Vallesia glabra (Cav.) Link	Apocynaceae	Cun cun
Verbena sp.	Verbenaceae	

Table A2.2. Species List from Transition *Algarrobo*/Savanna Forest Showing Patterns of Vegetative Growth, Flowering, Fruit Maturation, and Setting Seed after the ENSO Event of 1982

Forbs	January	February	March	April	May	June
Alternanthera peruviana		Vegetative	Vegetative	Vegetative, Flowering	Flowering	Flowering
Amaranthus dubius		Vegetative, Flowering	Flowering	Flowering, Fruiting	Fruiting	Setting seed
Aristida adscencionis			Vegetative, Flowering	Fruiting	Fruiting	Fruiting, Setting seed
Boerhavia verbenacea		Vegetative, Flowering	Flowering	Flowering, Fruiting	Setting seed	Setting seed
Crotalaria pumila		Vegetative	Vegetative, Flowering	Flowering	Flowering, Fruiting	Fruiting
Eragrostis ciliaensis			Vegetative, Flowering	Flowering	Fruiting, Setting seed	Setting seed
Euphorbia sp.		Vegetative	Flowering, Fruiting	Fruiting	Setting seed	Setting seed
Exodeconus maritimus	Vegetative	Vegetative, Flowering	Flowering	Flowering	Flowering	Flowering, Fruiting
Hoffmanseggia viscosa		Vegetative	Flowering, Fruiting	Flowering, Fruiting	Fruiting	Fruiting
Indigofera microcarpa			Vegetative	Vegetative, Flowering	Flowering, Fruiting	Fruiting
Ipomoea piurensis			Vegetative, Flowering	Flowering, Fruiting	Fruiting	Setting seed
Ipomoea crassifolia			Vegetative	Vegetative, Flowering	Flowering	Flowering
Isocarpha microcephela			Vegetative	Vegetative, Flowering	Flowering	Flowering
Luffa operculata	Vegetative	Flowering	Flowering	Flowering, Fruiting	Flowering, Fruiting	Fruiting, Setting seed
Lycopersicum pimpinellifolium		Vegetative, Flowering	Flowering	Flowering, Fruiting	Flowering, Fruiting	Fruiting
Panicum stramineum			Vegetative, Flowering	Flowering, Fruiting	Setting seed	Setting seed
Proboscidea altheaefolia		Vegetative, Flowering	Flowering	Flowering, Fruiting	Fruiting	Setting seed
Sesbania exasperata			Vegetative, Flowering	Flowering, Fruiting	Fruiting	Setting seed
Tephrosia cinerea			Vegetative	Flowering	Flowering, Fruiting	Fruiting
Tiquilia dichotoma	Vegetative	Vegetative	Vegetative, Flowering	Vegetative, Flowering	Vegetative, Flowering	Flowering, Fruiting
Tiquilia paronychioides	Vegetative	Vegetative	Vegetative, Flowering	Vegetative, Flowering	Flowering	Flowering, Fruiting
Tribulus sp.		Vegetative, Flowering	Vegetative, Flowering	Flowering	Fruiting	Setting seed
Trees/Shrubs						
Prosopis pallida	Fruiting	Vegetative	Vegetative	Vegetative	Vegetative	Vegetative
Capparis angulata	Vegetative	Vegetative	Vegetative	Vegetative	Flowering	Flowering
Capparis ovalifolia	Vegetative	Vegetative	Vegetative	Vegetative	Vegetative	Vegetative

Symbols: Vegetative Flowering Fruiting Setting seed

the list for the more humid dense *algarrobo* forest. The six-month period of the study cuts short the documentation of continued growth, particularly if, as so often happens, there was a second, lighter, rainy season within the twelve-month period after the beginning of a major ENSO event. The vegetation productivity focus of this study also leaves to one side the changes in the fauna brought about by vigorous growth of herbaceous vegetation which were described in Chapter 3.

Table A2.3. Species List from Dense *Algarrobo*/Forest Showing Patterns of Vegetative Growth, Flowering, Fruit Maturation, and Setting Seed after ENSO of 1982

Forbs	January	February	March	April	May	June
Acanthospermun hispidum		Vegetative	Flowering	Flowering, Fruiting	Fruiting	Setting seed
Anthephora hermaphrodita	Vegetative	Vegetative, Flowering	Flowering	Fruiting	Setting seed	Setting seed
Alternanthera peruviana	Vegetative	Vegetative	Flowering	Fruiting	Setting seed	
Cenchrus pilosus	Vegetative	Vegetative	Flowering	Flowering	Fruiting, Setting seed	Setting seed
Crotalaria mucronata		Vegetative	Vegetative	Flowering	Flowering	Flowering
Chloris virgata	Vegetative	Vegetative, Flowering	Flowering, Fruiting	Fruiting, Setting seed	Setting seed	
Cucumis dipsaceus	Vegetative	Vegetative	Flowering	Fruiting	Fruiting	Fruiting
Cyperus sp.			Vegetative	Flowering	Fruiting	Setting seed
Eragrostis cilianensis		Vegetative, Flowering	Flowering	Fruiting		Setting seed
Eragrostis ciliaris			Vegetative	Flowering	Flowering	Flowering, Fruiting
Heliotropum sp.			Vegetative	Flowering	Flowering	Fruiting
Indigofera sp.		Vegetative	Flowering	Flowering, Fruiting	Fruiting	Setting seed
Iresine sp.	Vegetative	Vegetative, Flowering	Flowering	Flowering	Fruiting	Setting seed
Ipomoea crassifolia					Vegetative	Flowering
Ipomoea piurensis		Vegetative	Vegetative	Vegetative, Flowering	Flowering	Flowering, Fruiting
Jacquemontia unilateralis				Vegetative	Flowering	Flowering
Ludvigia sp.			Vegetative	Flowering		
Luffa operculata	Vegetative	Vegetative	Flowering	Flowering	Fruiting	Fruiting
Lycopersicum pimpinellifolium	Vegetative	Vegetative, Flowering	Flowering	Flowering	Flowering	Flowering, Fruiting
Merremia aegyptia				Vegetative	Flowering	Flowering
Momordica charantia			Vegetative	Flowering	Flowering	Flowering, Fruiting
Monina sp.					Vegetative	Flowering
Physalis angulata	Vegetative	Flowering	Fruiting	Fruiting, Setting seed	Setting seed	
Plumbago sp.				Vegetative	Flowering	Flowering
Solanum americanum		Vegetative	Flowering	Flowering, Fruiting	Fruiting, Setting seed	Setting seed
Tephrosia cinerea			Vegetative	Flowering	Fruiting	Fruiting
Trees/Shrubs						
Prosopis pallida	Fruiting	Vegetative	Vegetative	Vegetative	Vegetative	Vegetative
Capparis angulata	Vegetative	Vegetative	Vegetative	Vegetative	Vegetative	Vegetative
Capparis ovalifolia	Vegetative	Vegetative	Vegetative	Vegetative	Vegetative	Vegetative

Symbols: Vegetative Flowering Fruiting Setting seed

A third study carried out in Piura to identify trees suitable for dendrochronological studies has also provided extraordinary insight into the impact on tree species adapted to the extremely seasonal rainfall regimes of these dry forests. One of the difficulties in reconstructing the dry forests

of the Nanchoc and Jequetepeque study area is the almost complete loss of the trees that today are considered to have commercial value as timber (Dourojeanni 1981; Rodríguez et al. 1993). Rodríguez and his team visited multiple locations from the desert scrub region to an elevation of 500 in the piedmont in order to assemble their list. The species encountered and their habitats are given in Table A2.4. Few of these species are present even in the Nanchoc basin today. This study shows that in all probability the reasons for their absence are in large part commercial logging and grazing. Sapling *palo santo* (*Bursera graveolens*) trees were observed growing on a hillside north of Nanchoc village in 1985, three years after the 1982 ENSO event. This species is characterized as being fast growing. The soft wood is used in fruit crates as indicated in Table A2.4. This was, in fact, the explanation given when it was noticed that the trees had all been cut down. Had those trees remained in place, in time the hillside would have been covered by a copse of trees some 10 m or more tall. Undisturbed *palo santo* grows to a height of 20 m in favorable conditions in coastal El Oro Province, Ecuador, just east of Tumbes. Among the trees listed in Table A2.4, hackberry (*Celtis iguanea*) and *zapote* (*Capparis angulata*) produce fruits that have been recovered archaeologically in the study area (Rossen 1991). *Algarrobo* was also extensively utilized (Rossen 1991; Stackelbeck 2008).

Since the focus of this study was finding tree species suitable for tree-ring counts, the authors concentrated on the trees that would provide data on growth patterns. All of the trees in Table A2.4, except *zapote* (*Capparis* sp.), show distinct bands of growth and dormancy. Figure A2.1, redrawn from their study, plots the growth rings against time. A pattern of rapid growth during periods of rain (the 1982–1983 ENSO event) separated by periods of dormancy is very clear. Observed across species like this, estivation can be seen to be a basic adaptation to long periods of extreme aridity punctuated by short periods with increased precipitation. It is noteworthy here that the attenuated seasonal rainfall that sometimes falls in piedmont regions closest to the highlands in geographic locations analogous to the middle and upper Nanchoc basin does not seem to affect this pattern of growth.

The growth pattern of zapote (*Capparis* sp.) is also noteworthy. This tree grows as a prostrate shrub in the most extreme arid environments of the coast (Sagástegui 1973). In more favorable conditions it grows as a small tree and is long-lived (Rodriguez et al. 1993). It differs in its growth mechanism, however, from the other trees studied. It does not produce complete growth rings and grows continually through periods of extreme

Table A2.4. Species List and Habitat Description for Dry Forest Trees Present in Piura

			Maximum dimensions			
Common name	Scientific name	Habitat	Height	Diameter	Uses	Observations
Sapote	*Capparis angulata*	desert, wasteland	<8 m	80 cm	handicrafts, firewood	evergreen, long-lived
Hualtaco		foothills	<20 m <500 m	70 cm	parquet, fencing	rapid growth
Palo Santo	*Bursera graveolens*	foothills	<10 m <500 m	50 cm	wooden crates	rapid growth
Guayacán	*Tecoma* sp.	foothills	<15 m <500 m	50 cm	furniture	
Algarrobo	*Prosopis* sp.	desert, valleys wasteland,			firewood	high heat
Palo verde	*Cercidium praecox* (Huaman) or *Caesalpinia praecox*	foothills	<5 m	25 cm	handicrafts (spoons)	
Palo blanco	*Celtis iguanea* or *Celtis triflora*		<15 m	55 cm		
Frejolillo or (Sune)	*Capparis millis* HBK	foothills	<5 m			
Charán	*Caesalpinia Corymbosa*	foothills	<6 m	80 cm		
Faique	*Acacia tortuosa or Acacia macracntha*	foothills				
Barbasco	*Jatropha* sp.	foothills				
Pasayo	*Bombax discolor*					
Vichayo	*Capparis ovalifolia*	wasteland	<3 m	20 cm		
Ceibo	*Ceiba pentandra or Eriadendron anfractuosum*	foothills	<15 m	80 cm		

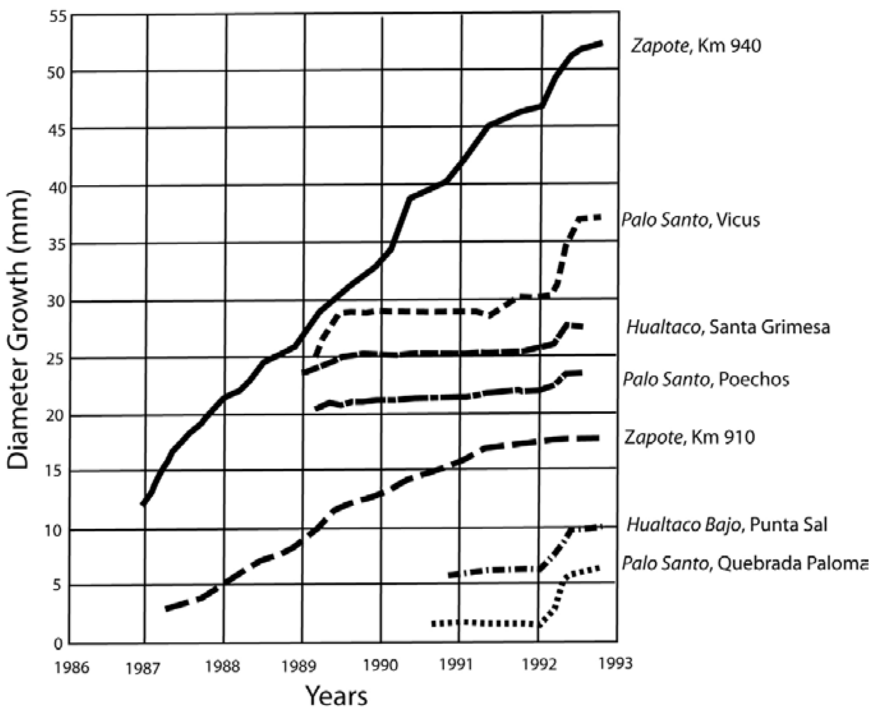


Figure A2.1. Graph of growth patterns of dry forest trees during dry and wet periods (redrawn from Rodríguez et al. 1993).

aridity and only somewhat more rapidly in the presence of rainfall, as can be seen from the slope of the curve in Figure A 2.1. All of the other tree species, which produce complete growth rings, show a pattern of no growth or dormancy during periods (years) without rainfall followed by very rapid growth spurts in the presence of moisture. Growth is shut off when arid conditions return. This would appear to be a well-established adaptation to extreme conditions in a seasonal forest that has been in place for a long period of time.

CONCLUSION

Reconstructing past environments through archaeology is a dialectical process. Archaeological excavation may recover specific botanical information – macro-botanical samples, pollen, phytoliths, or starch grains – which can be identified to particular plant species. It is often difficult to key such information into particular biomes. Identification of the biomes contemporaneous with the archaeological occupation is a first step. It is clear that the early human occupation in the Nanchoc and Jequetepeque portions of the larger study region occupied somewhat different biomes,

probably adjacent or nearby points on a continuum. What is more difficult, without botanical proxies, is reconstructing the content of each association. To accomplish this reconstruction, the surviving plant species of the different dry forest and wetland associations have been used insofar as possible to characterize particular biomes, taking into consideration the broad distribution of some plants such as *algarrobo*, the specific adaptations of other plants which are found broadly, but as distinct species like the *zapote*, *Capparis* (Capparis sp.)

The northern connections of the flora of the dry forest associations of the study region with plant communities to the north have been used to recover types of vegetation now missing, as is the case with the larger trees, and has permitted a tentative and more complete reconstruction of the dry forest biome. Much remains to be done; many pollen samples and starch grains have not yet been identified because there is no comparative material. The richness of the dry forest biome is clear. Plant adaptations to seasonality bring rewards for foraging human populations in the form of carbohydrates stored in specialized structures such as tubers. Knowledge of the survival strategies of the plants living in this biome leads to a better understanding of the environment and the adaptations required of the early human populations living within it.

APPENDIX THREE

Stable Carbon Isotopes

Patricia J. Netherly

The two naturally occurring isotopes of carbon, C^{13} and C^{14}, are found in slightly different proportions. These proportions are stable and can be recovered from the soils in which the plant material decayed. Photosynthesis is one chemical process that impacts the ratio of C^{13} to C^{14} found in plants, which can be identified from the decayed organic matter present in the soil. There are three distinct photosynthetic pathways that leave different isotope signatures: C_3, C_4, and CAM (Crassulacean acid metabolism). Most plants use the C_3 pathway. Only about 5 percent of all plants use the C_4 pathway. Nearly half of the plant species using this pathway are tropical grasses. While C_4 plants may exhibit sensitivity to extreme temperature changes and a more efficient use of CO_2 in conditions of reduced availability of that gas, neither condition was present in the study region after the Last Glacial Maximum (LGM). Finally, the CAM pathway of plant photosynthesis is found in about 10 percent of all plant species. Prominent among the families with the CAM pathway are the Cactaceae, the Bromeliaceae, the Euphorbiaceae, and other succulents. Many are adapted to arid environments, closing their stomata during the day and taking in CO_2 at night to conserve water (Boutton 1996). Stable isotope values for C_3 plants range between −32 percent and −22 percent. The range of values for C_4 plants and most CAM plants is −17 percent to −9 percent (Boutton 1996).

The values recovered in the samples from Quebrada Talambo in the Chamán sector of the Jequetepeque Valley are given below in Table A3.1. These sites date to ~10,000 years before the present with values of −27.3 to −23.4, all firmly within the range for C3 plants. This suggests that at that time conditions were mesic and were not sufficiently arid to support either C4 or CAM plants better adapted to semi-arid or arid conditions. Unfortunately, there are no later samples for this area that might reflect the more arid conditions of the mid to late Holocene.

Table A3.1. Stable Carbon Isotope Data from the Jequetepeque Valley

Site no.	Sample no.	$\delta^{13}C \pm 1\sigma$	Depth	Zone/Unit	Level	Other	Associated C14 dates
JE431	CR-111030	–23.5	5–10 cm	TU 14	1		
JE431	CR-111031	−23.5	10–15 cm	TU 14	1		9041–48 (10,282–10,043 cal BP)
JE431	CR-111032	−23.4	15–20 cm	TU 14	1		8083–65 (10,244–9912 cal BP)
JE431	CR-111033	−23.5	20–25 cm	TU 14	1		
JE431	CR-111034	−23.8	25–30 cm	TU 14	Trans. 1/2		
JE431	CR-111035	−24.6	30–35.cm	TU 14	Trans. 1/2		10270–9939 cal BP
JE431	CR-111036	−26.8	35–40 cm	TU 14	2		
JE431	CR-111037	−25.3	40–45 cm	TU 14	2		
JE790	CR-111038	−23.4	0–5 cm	TU 8	1		
JE790	CR-111039	−27.3	5–10 cm	TU 8	1		10679–10306 cal BP
							11131–10600 cal BP
JE790	CR-111040	−26.2	10–15 cm	TU 8	1		
JE790	CR-111041	−25.3	15–20 cm	TU 8	Trans. 1/2		
JE790	CR-111042	−25.9	20–25 cm	TU 8	Trans. 1/2		
JE 996	CR-111043	−23.9	0–5 cm	TU 2	1		
JE 996	CR-111044	−25.7	5–10 cm	TU 2	1		12230–11653 cal BP
JE 996	CR-111045	−24.6	10–15 cm	TU 2	2		12037–11360 cal BP
JE 996	CR-111046	−26.2	15–20 cm	TU 2	3		l2822–12413 cal BP
							12571–11986 cal BP

After Stackelbeck 2008, Table 5.2.

Table A3.2. Stable Carbon Isotope Data from Zaña Samples

Site no.	Sample no.	$\delta^{13}C \pm 1\sigma$	Depth	Zone/Unit	Level	Other	Associated C14 dates
CA09–04	1	−18.02		B.N110E110	4		8274–7677 cal BP
CA09–19	2	−22.14	210–225 cm.	A.P1	15		5554–4988 cal BP
CA09–19	3	−22.58	75–90 cm	P2	6		3542–3280 cal BP
CA09–19	4	−21.30	45–60 cm	A.P2	4		1976–1765 cal BP
CA09–27	5	−21.25	10–20 cm	N0 W62.N2			8541–8199 cal BP
CA09–27	6	−21.78	30–40 cm	N2 W59.N4		Feature 3	9005–8370 cal BP
CA09–27	7	−21.22	20–30 cm	N3 W60.N3		Feature 2	8587–8370 cal BP
CA09–27	8	−21.70 ± .48			4		9002–8427 cal BP
CA09–27	9	−23.98		N0 W62,N2	1		
CA09–27	10	−21.77		N2 W59.N4	5	Feature 3	9256–8378 cal BP
CA09–27	11	−24.48		N3 W60.N3	6		9481–860 cal BP
CA09–27	12	−22.93		N2 W62,N5	8	Feature 5	9580–896 cal BP
CA09–27	13	−22.55		N3,4 W31	9	Platform	11820–10815cal BP
CA09–28	14	−21.81 ± .04	30–40 cm	S1 W0.N4		Burial 5	9516–8658 cal BP
CA09–28	15	−22.38		S3,4 W5		Burial 3	9481–8606 cal BP
CA09–50	16	−22.18 ± .06		N1 × 1	2	Wesr Wall	
CA09–50	17	−23.70	0–10 cm	S1 × 1 PZ1	N-1	NW corner	~6900 cal BP
CA09–52	18	−21.25 ± .27		N10 W8.N4			~7600 cal BP
CA09–52	19	−23.09	30–40 cm	S10 W7.N4		NE corner	~7700 cal BP
CA09–52	20	−20.94	20–30 cm	S10 W9.N.3			~7600 cal BP
CA09–52	21	−22.66	30–40 cm	S12 W4.N.4		Burial 1	~7600 cal BP
CA09–52	22	−21.11	30–40 cm	S12 W7.N.4		Burial 1	8535–8342 cal BP
CA09–52	23	−22.74	30–40 cm	S13 W8.N.4			9002–8427 cal BP
CA09–80	24	−20.45	0–10 cm	S1 × 1.N.1	PZ2		~8400 cal BP
CA09–19	25	−21.65	105–120 cm	A.U2	8		4844–4445 cal BP
CA09–19	26	−22.00	90–105 cm	A.U2	7		

$\delta^{13}C$ ($^{13}C/^{12}C$) is in parts per mil (‰) relative to the international standard PDB ($\pm 1\sigma$).

The values for site JE-996, located at a somewhat higher altitude in the Q. del Batán, and somewhat earlier – 11,000 to 12,000 years ago – are consistent with these results, ranging from −26.2 to −23.9. This suggests that both areas had similar vegetation, despite their topographic differences.

The samples from the Nanchoc area are somewhat later, falling between 6,500 and 7,500 years ago. The stable isotope values range from −24.4 to −20.4 for the sites within Q. Tierra Blanca. There is a lower value of −18.0 for CA-09−04 on the north side of the valley. All of these values fall within the range for C3 plants, although they are within the lower portion of that range. This may reflect somewhat more arid conditions, particularly at CA-09−04 (Boutton 1996). However, it should be borne in mind that the entomological data suggest that this site at approximately the same time period was mesic enough to support beetle larvae in the ground (see Chapter 3).

Samples along a more extensive transect with control for time are needed to fully test the appropriateness of recreating of the paleoenvironment by means of stable carbon isotope assays. Determining the photosynthesis pathways of the principal constituents of the dry forest would be necessary as well.

APPENDIX FOUR

Faunal Species Present in Preceramic Assemblages by Phase in the Jequetepeque and Zaña Valleys

		Early Preceramic		Middle Preceramic	
Taxon	**Common name**	**Early El Palto**	**Late El Palto**	**Las Pircas**	**Tierra Blanca**
Mammals					
Pseudalopex sp.	South American Fox	•	•	•	
Dusicyon sp.	Fox			•	
Felis cf. *yaguaroundi*	Jaguarundi			•	
Odocoileus sp. v peruvianus	White Tail Deer			•	
Odocoileus virginianus (?)	White Tail Deer			•	
Ozotoceros bezoarticus (?)	Pampas Deer			•	
Mazama sp.	Brocket Deer		•		
Tayassuidae	Peccary		•		
Sciurus sp.	Tree Squirrel		•		
Oryzomys sp.	Rice Rat			•	
Canidae	Indeterminate Canine			•	
Canidae (?)	Indeterminate Canine			•	
Sigmodontinae	New World Rats / Mice	•	•		
Cervidae	Deer		•	•	
Mustelidae	Mustelids		•		
Cricetidae	Indeterminate Rat/ Mouse			•	
Rodentia	Indeterminate Rodent		•	•	
Carnivora	Indeterminate Carnivore		•	•	
Artiodactyla	Indeterminate Even-Toed Ungulate		•		
Ungulate	Indeterminate Hoofed Animal			•	
Mammalia	Indeterminate Mammal	•	•	•	•
Birds					
Nothoprocta pentlandii	Andean Tinamou			•	
Mimus sp.	Mockingbird			•	

(continued)

(*continued*)

Taxon	Common name	Early Preceramic		Middle Preceramic	
		Early El Palto	Late El Palto	Las Pircas	Tierra Blanca
Mimidae	Thrush / Thrasher			•	
Columbidae	Dove / Pigeon		•		
Phalacrocoracidae	Cormorant			•	
Passeriformes	Perching Bird		•		
Aves	Indeterminate Bird		•	•	
Reptiles					
Dicrodon guttulatum	Desert Tegu			•	
Dicrodon sp.	Desert Tegu	•	•	•	
Callopistes flavipunctatus	Lizard			•	
Spilotes pullatus	Racer-like Snake			•	
Teiidae	Indeterminate Lizard		•		
Iguanadae	Indeterminate Iguana			•	
Lacertilia	Indeterminate Lizard	•	•		
Squamata	Indeterminate Lizard			•	
Reptilia	Indeterminate Lizard			•	
Amphibia					
Bufonidae	Frog			•	
Ranidae	Frog			•	
cf. Caudata	possible Salamander		•		
Bony Fishes					
cf. *Calamus brachysomus*	Pacific Porgy		•		
Micropogonias sp.	Finebarbel Croaker		•		
Mugil sp.	Mullet		•		•
Bothidae	Lefteye Flounder		•		
Sciaenidae	Drum / Croaker		•		
Teleostei	Ray-Finned Fish			•	
Osteichthyes	Indeterminate Bony Fish		•		•
Cartilaginous Fishes					
Rajiformes cf. Dasyatidae	Stingray*	•	•	•	
Chondrichthyes	Indeterminate Shark / Ray		•		
Crustaceans					
Pleocyemata cf. Anomura or Brachyura	Crab			•	
Decapoda	Indeterminate Crab	•		•	
Crustacea	Indeterminate Crab			•	
Marine Mollusks					
Cerithidea valida	Mud Snail			•	
Choromytilus chorus	Giant Mussel			•	
Aulacomya ater	Mussel			•	
Naticide sp.	Sea snail			•	
Aequipecten urpuratus	Marine bivalve			•	
Tivella sp.				•	
Mesodesma donacium	Clam			•	
Protothaca taca	Clam			•	

Taxon	Common name	Early Preceramic: Early El Palto	Early Preceramic: Late El Palto	Middle Preceramic: Las Pircas	Middle Preceramic: Tierra Blanca
Donax peruvianus	Clam			•	
Iphigenia altior	Clam			•	
Gastropoda	Indeterminate Marine Mollusk			•	
Terrestrial Mollusks					
Scutalus sp.	Land Snail	•	•	•	•
**	Mixed Land Snails			•	
Pulmonate	Indeterminate Land Snail			•	
Mollusks (Indeterminate)					
Mollusca	Indeterminate Mollusk			•	
Unidentified					
Vertebrata	Indeterminate Vertebrate	•	•	•	
Animalia	Indeterminate Animal			•	

• *Indicates presence of this species.*
* Represented by spine(s); as such, this is not likely a food resource, but a special object.
** These assemblages variously included mixes of terrestrial land snails, including *Scutalus* sp. (cf. mutabilis); *Drymaeus vexillum*; *Drymaeus* sp.; and *Bostrux elegantus*.

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